33rd Year JANUARY, 1950

RUBBER AGE

OZONE RESISTANCE.....

TYSONITE

Flexible thermoplastic solid—Protects rubber from the deteriorating effect of ozone.

HARD HYDROCARBON

Used as a diluent with rubber stocks. Possesses high dielectric strength.

BLACK-OUT

A flexible coating material—practically impervious to ozone. Decorative as well as protective . . . can be colored.

R. T. VANDERBILT CO. INC.

230 Park Avenue, New York 17, N. Y.

Use the Du Pont Antioxidant that Fits Your Needs

	FOR PROTECTION AGAINST		
	NORMAL AGING	HEAT AGING	FLEX FAILURE
1 NEOZONE A	Excellent	Good	Good
2 AKROFLEX C	Excellent	Excellent	Very Good
3 THERMOFLEX A	Excellent	Excellent	Excellent
4 ANTOX	Very Good	Very Good	No Effect

NEOZONE A—As a general-purpose antioxidant, Neozone A is outstanding in effectiveness and economy. It provides excellent protection against normal aging and improves the heat-aging and flex-cracking resistance of both natural and synthetic rubber stocks. Equal antioxidant protection may be obtained using Neozone D. However, Neozone A is much more soluble in elastomers, hence is preferable.

AKROFLEX C—Second only to Thermoflex A for protecting stocks against all three types of deterioration. Gives protection equal to Thermoflex A against normal aging and heat, but is slightly less effective against fatigue failures.

THERMOFLEX A—For applications requiring *maximum protection against all three types of deterioration* . . . normal aging, heat, and flexing . . . Thermoflex A is unmatched. Especially effective as an inhibitor of flex cracking. Specify Thermoflex A for difficult jobs where only the best antioxidant protection will do.

ANTOX—Produces excellent aging stocks which discolor only slightly on exposure to sunlight. Antox also results in stocks having very good heat resistance. And, too, Antox activates cure . . . reduces accelerator requirements.

DU PONT RUBBER CHEMICALS

E. I. du Pont de Nemours & Co. (Inc.),
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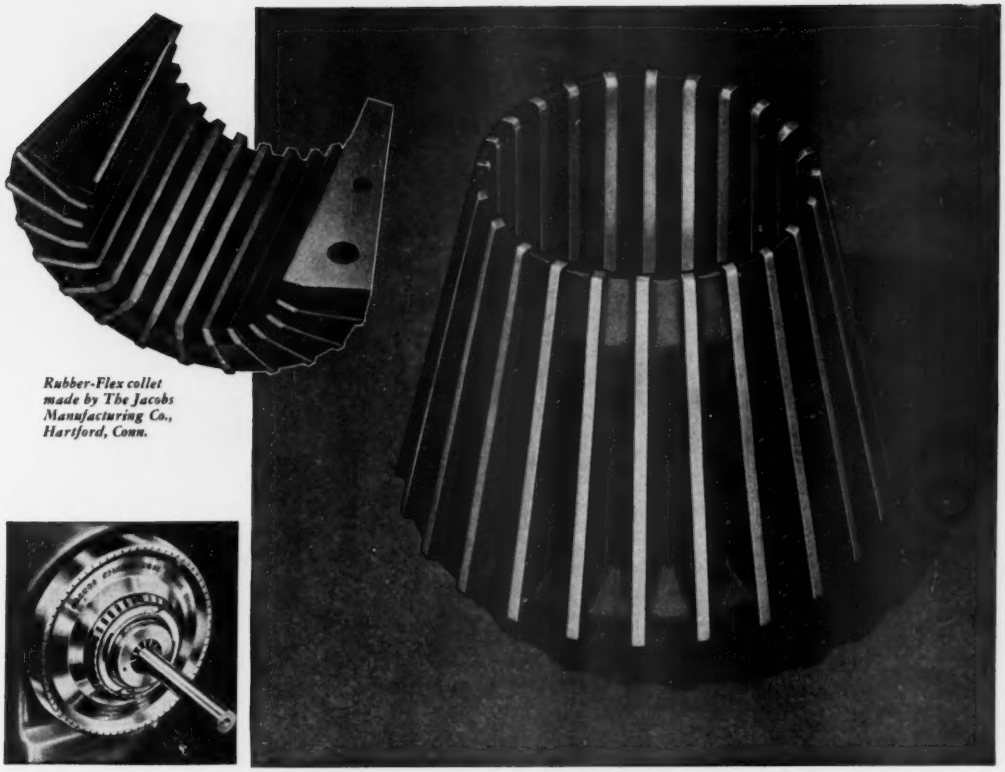
Tune in to Du Pont "Cavalcade of America," Tuesday Nights—NBC Coast to Coast

THE RUBBER AGE, published monthly by The Palmerton Publishing Co., Inc., Printing Office, East Stroudsburg, Pa. Editorial and Advertising Offices at 250 West 57th Street, New York 19, N. Y. Entered as second class matter October 20, 1933, at the Post Office at East Stroudsburg, Pa., under the Act of March 3, 1879. Subscription in United States, $3.00 a year; Canada, $3.50; Foreign, $4.00. January, 1950, Vol. 66, No. 4.



Rubber-Flex collet made by The Jacobs Manufacturing Co., Hartford, Conn.

Does the work of 8 collets ...with HYCAR'S help!

MEN who know lathes say the new Jacobs Spindle Nose Lathe Collet Chuck is a world-beater. And one of the important reasons for its success is the Rubber-Flex collet—in which Hycar American rubber is a vital part.

This collet, pictured above, is made of hardened steel jaws bonded and mechanically locked together with Hycar. Each collet has a full ⅛" gripping capacity—making it possible for one Rubber-Flex collet to cover the range of eight split steel collets!

Here's why Hycar is fundamental in the chuck design: the rubber in the collet has to have excellent resistance to heat and to the deteriorating effects of coolants and cutting compounds. On both counts, Hycar fills the bill perfectly.

Another important point: Hycar's resistance to compression set makes it possible for the molded rubber to take *all* of the flexing action. Under tests—over four million individual openings and closings—there was no breakdown in the Hycar rubber or separation from the steel collet jaws. You can see what that means in long collet life under heavy duty use.

Use of Hycar in this unusual collet is another in a long series of product successes. For versatile Hycar is used as a base material . . . as a plasticizer for polyvinyl resins . . . as a modifier for phenolic resins . . . as an adhesive base . . . as a latex for coating or impregnating. Find out how Hycar may help you develop or improve products, profitably. Just write Dept. HA-1, B. F. Goodrich Chemical Company, Rose Building, Cleveland 15, Ohio.

Hycar Reg. U.S. Pat. Off.
American Rubber

B. F. Goodrich Chemical Company A DIVISION OF THE B. F. GOODRICH COMPANY

GEON polyvinyl materials • HYCAR American rubber • GOOD-RITE chemicals and plasticizers

For long flex life, you ought to know
The records made with **Philblack* O!**

Write for the technical data on Philblack O! Read the results of flexing tests! Look at the graphs and comparisons! You'll see that Philblack O gives up to 40% longer flex life than channel black in natural and synthetic rubbers. And Philblack compounds have from 10% to 30% better abrasion resistance, too. For a long, useful life, use Philblack O!

The best way to prove all this is to send for a trial order of this tough **HAF** black . . . and see for yourself! Available in bags or in bulk.

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Warehouses in Akron, Boston, Chicago and Trenton. West Coast agent: Harwick Standard Chemical Company, Los Angeles. Canadian agent: H. L. Blachford, Ltd., Montreal and Toronto.

*A Trademark

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in drums, convenient bags or as masterbatch in cartons.

Pick your package—

PLIOLITE S-6 comes the way you want it

As one more service to its customers—Goodyear supplies **Pliolite S-6** in a choice of easily-handled packages. **Pliolite S-6** comes in 200-pound drums or in 50-pound bags, so you can request this use-proved copolymer in whichever container best meets your handling facilities.

Either way you order, you'll find **Pliolite S-6** can be easily dispersed in the Banbury or on the mill. Or if you wish you can have **Pliolite S-6** *as masterbatch* — a thorough dispersion of the resin in rubber, packed in 200-pound cartons.

Regardless of the form of **Pliolite S-6** you order, when you include it in your gum, black or non-black loaded stocks, this copolymer resin will improve tensile, tear, hardness, stiffness, flex-life and abrasion resistance. Whenever you want a low-gravity, light-colored stock of high strength and easy processability, you can use **Pliolite S-6** with confidence. For details and sample, write:

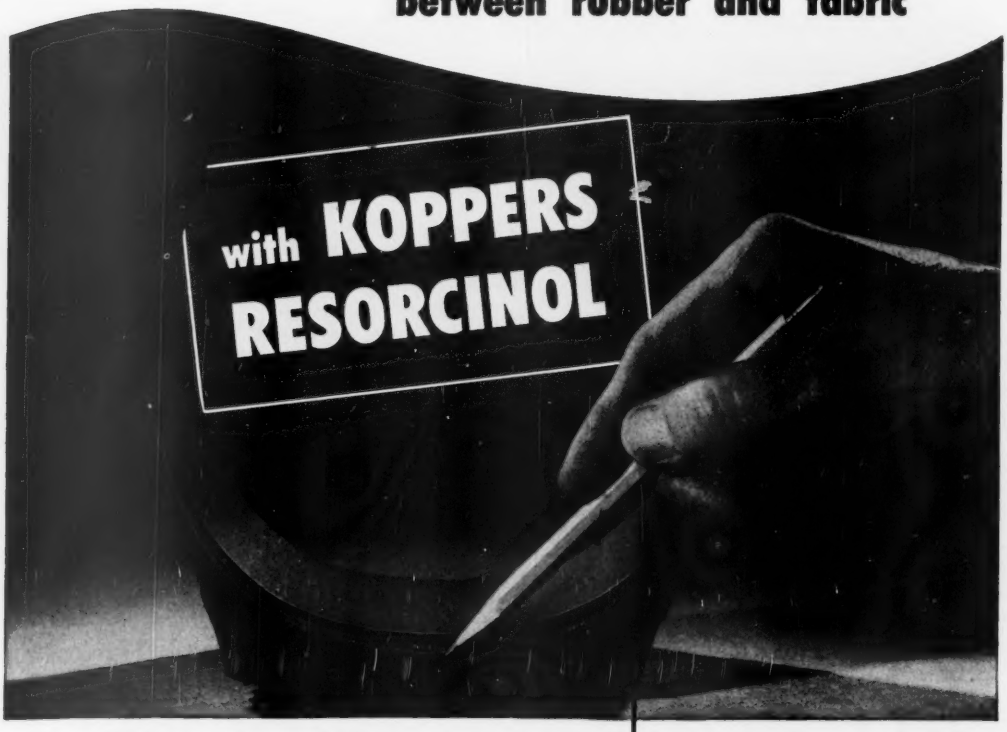
GOODYEAR, CHEMICAL DIVISION
AKRON 16, OHIO

USE PROVED *Products*

GOODYEAR

Pliolite—T. M. The Goodyear Tire & Rubber Company

How to make a *Stronger bond* between rubber and fabric



TIRES, belting and other products which include laminations of rubber and fabric or cords are serviceable only as long as the parts hold together. To obtain best adhesion of rubber to fabric or cords, it is common practice to pre-treat the fabric in a mixture of rubber latex and some adhesive material. For this purpose adhesives prepared with Koppers Resorcinol are proving highly successful.

Recent tests have shown that Koppers Resorcinol Adhesives used in the pre-dip treatment produce a much stronger bond than casein. This is true with cotton, rayon and nylon fabrics but the most marked improvement is shown on the rayon and nylon.

You can prove this for yourself in your own laboratories. Write for a sample of Koppers Resorcinol and a copy of our Technical Bulletin.

MORE STRENGTH HERE. Pre-treatment of the tire fabric with Resorcinol Adhesives in the latex mixture assures a stronger bond between the fabric and the tread.

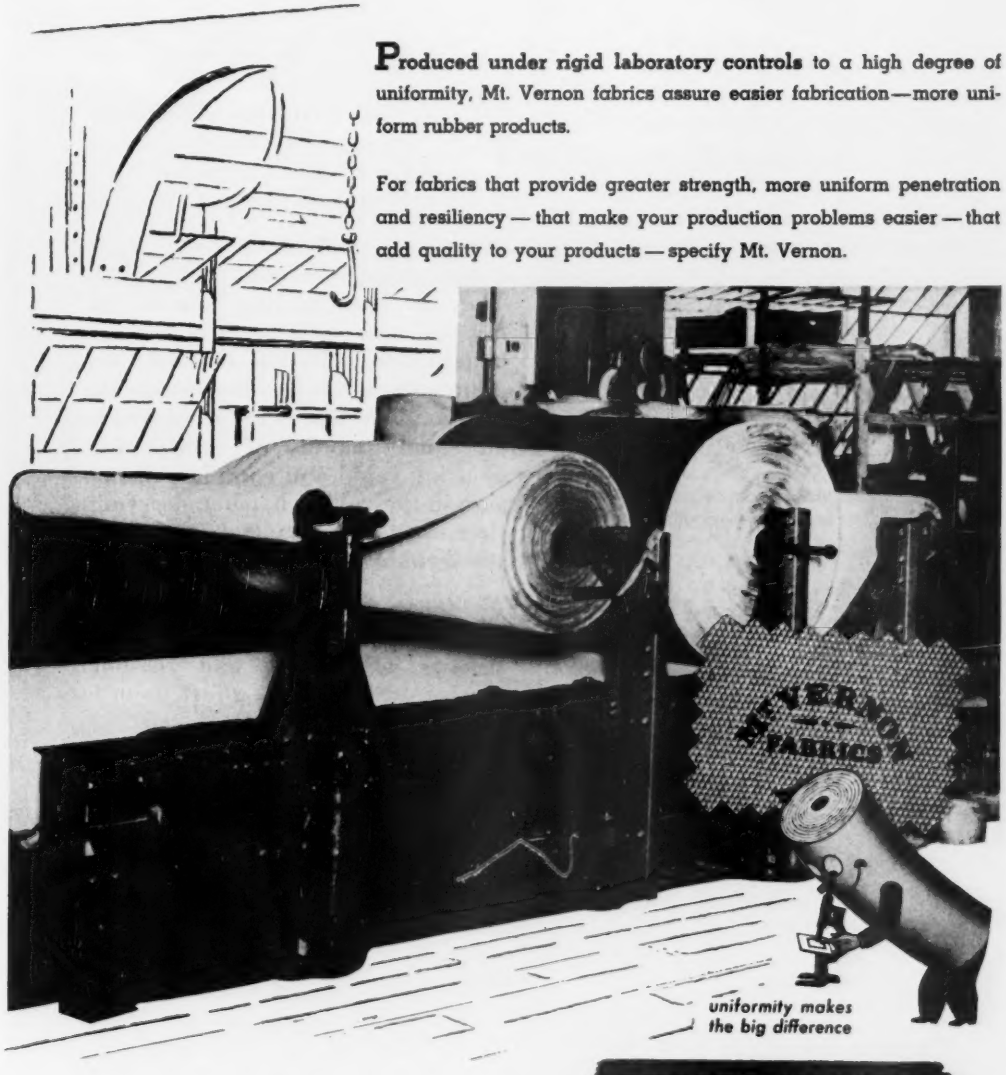
KOPPERS

KOPPERS COMPANY, INC.

Chemical Division

Pittsburgh 19, Pa.

The Fabric in Fabrication Means More when it's a Mt. Vernon Fabric



Produced under rigid laboratory controls to a high degree of uniformity, Mt. Vernon fabrics assure **easier** fabrication—more uniform rubber products.

For fabrics that provide greater strength, more uniform penetration and resiliency — that make your production problems easier — that add quality to your products — specify Mt. Vernon.

uniformity makes the big difference

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Cooke's Complete Line of PROVED Rubber Colors

If you have not received our Rubber Color folder, containing 21 specimens of COOKE colored rubber stocks, send for your copy today!

The COOKE COLORS are quality colors which give clean, sharp, brilliant tones in natural rubber, synthetic rubbers and vinyl type plastics.

They will stand all cures — open steam, press, ammonia, acid and CV. They are non-bleeding, non-migrating and non-crocking, and are soft and pliable. COOKE COLORS are clean and easy to handle because the pure organic toners are dispersed in an equal quantity of rubber thus assuring rapid and complete dispersion in the rubber batch and permitting exact color control of the finished rubber product.

As for aging properties, COOKE COLORS are unsurpassed and long periods of storage and seasonal temperatures will not affect them in any way.

There are 21 colors in the COOKE line—a type for every job . . . but they may be blended to get an even larger range of colors.

Whatever your color problems are, we can help you.

Cooke

COOKE COLOR & CHEMICAL CO.

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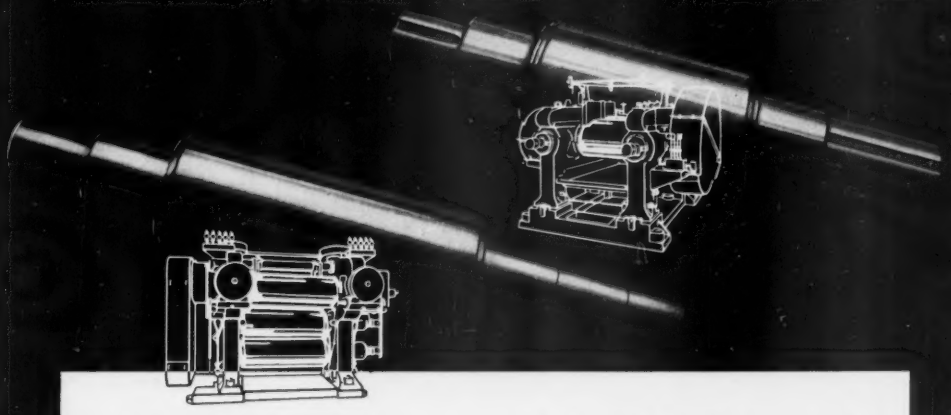

The ability of Farrel-Birmingham to produce rolls to meet your needs exactly results from a century of service to the rubber industry.

Experience in building a wide variety of roll-equipped processing machines guides company engineers in selecting the proper metal mixture . . . in determining the best method of heating or cooling the roll uniformly . . . and in designing the roll to withstand the punishment it will receive in service.

Farrel-Birmingham rolls are produced in the *world's largest specialty roll shop* at Ansonia—a shop equipped to make rolls of any size required, and in many different metal formulas, of chilled iron, alloy iron, gray iron, Meehanite metal or steel. Here, each step in manufacturing is closely controlled, from metallurgical analysis of raw materials to final inspection of the finished roll.

When you need roll renewals or other processing equipment, call Farrel-Birmingham.

Farrel-Birmingham

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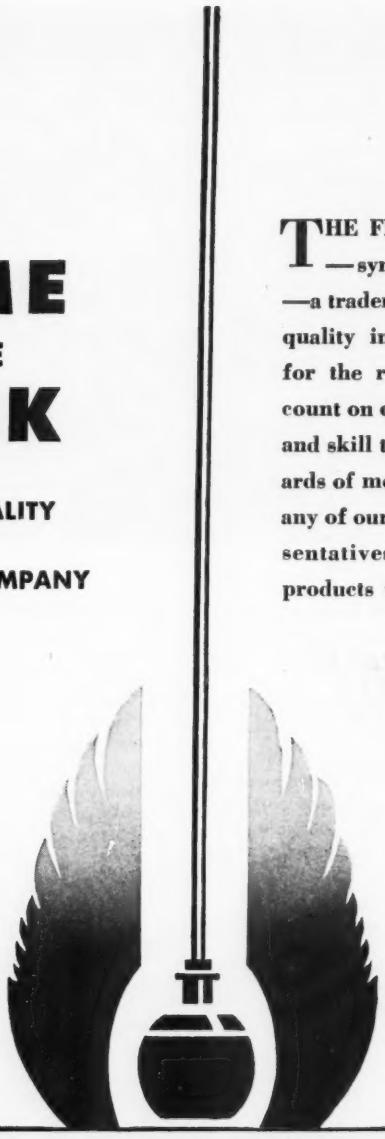
THE FLAME AND THE FLASK —symbol of the C. P. Hall Co. —a trademark that means precision quality in compounding materials for the rubber industry. You can count on our 30 years of experience and skill to meet the exacting standards of modern production. Contact any of our technically trained representatives for information about products that perform.



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X-1 RESINOUS OILS

WHITE WALL TIRE STOCKS

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How NEVILLE can serve the Rubber Industry

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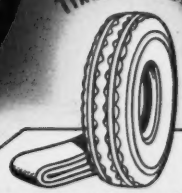
TIRES & TUBES



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MOLDED PRODUCTS

NEVOLL
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Why not call on Neville's years of research and experience for help on your rubber production problems?

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RUBBER SOLES & HEELS

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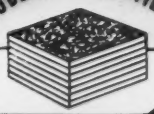
RUBBER FLOOR TILE



R-12 • R-16
LX-685

a Products listed are all coumarone resins except Nevoll and X-1 Resinous Oil

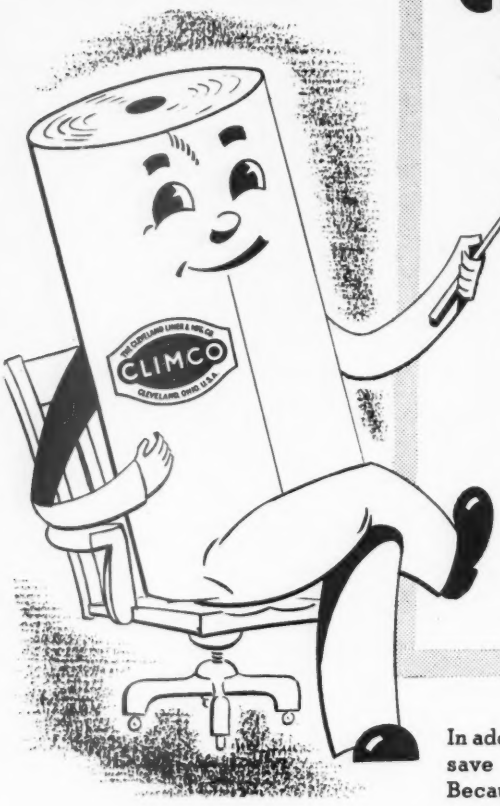
THE NEVILLE COMPANY

PITTSBURGH 25, PA.

Chemicals for the Rubber Industry

R-10

MR. CLIMCO SAYS...



CLIMCO LINERS

benefit stocks in all these ways -

- Lint and ravelings are eliminated
- Air, moisture and sunlight are excluded
- Oxidation, mould and bloom are prevented
- Freshness and tackiness of stock are preserved
- Stock gauges are more easily maintained
- Latitude in compounding is enlarged

In addition to these important features, Climco Liners save time and money in production operations... Because they separate perfectly, stock adhesions that cause costly down time are eliminated.

Since 1922, leading rubber companies have found that Climco Processing repays its moderate cost many times over. Give them a trial in your plant.

ILLUSTRATED LINER BOOKLET

Tells all about Climco Liners and Linerette and how to get better service from liners. Write for your copy now.

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PROCESSED LINERS

Serving the Rubber Industry for 26 Years

EXTERNAL LUBRICANT

Prevents adhesion of hot rubber slabs when stacked or piled . . . banishes dust nuisance by replacing soapstone or talc . . . prevents sticking during cure of extrusions and flat pan coiled tubing . . . excellent release agent for molds, mandrels, air bags, belt drums . . . equally satisfactory for washing and finishing inner tubes and mechanical goods . . . imparts satiny finish . . . greatly aids in the processing of insulated wire and cable. The Production Departments and Laboratories of many rubber manufacturers, through years of using GLYCERIZED, give ample proof of its outstanding qualities as an external lubricant for natural, synthetic and reclaimed stocks.

INTERNAL LUBRICANT

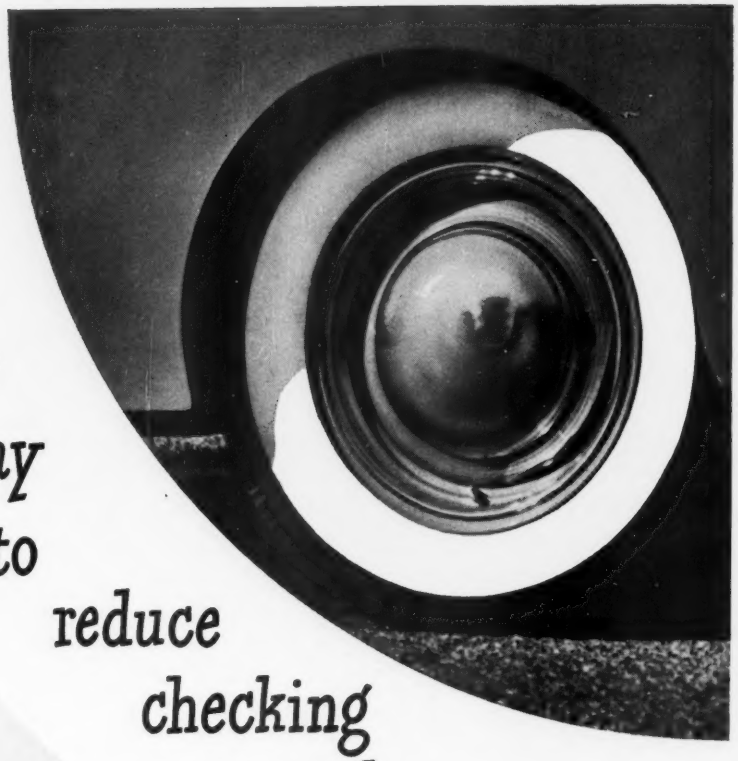
For natural, synthetic and reclaim compounds . . . aids dispersion during milling and provides thorough mixing action of all compound ingredients . . . replaces softeners and due to its freedom of swelling action upon the rubber hydro-carbon, it produces the desirable qualities of softeners, without causing impairment and loss of strength . . . improves processing, calendering and extrusion by producing softness and lubrication without stickiness . . . produces a smoother finish on extrusions . . . helps flow during molding and because of its non tack producing properties, articles break clean and easily from molds . . . adds luster to finished articles.

EXTRUSION LUBRICANT

Prevents adhesion of sealing lips of channel rubbers and other types of extruded strips, even in feather edged forms . . . clean, smooth edges—free from tackiness or adhesion—plus simplified handling, result from its use . . . imparts a strong and tenacious, yet thin film to extruded goods, which does not break down before or during cure . . . through its use costly hand labor, which is necessary in separating sticking of sealing lips after cure, is eliminated . . . rejects, particularly strips formed with curved corners and then cured, are reduced to a marked extent . . . no effect on rubber other than to impart its non-adhesive properties . . . lowers production costs.

Technical data and samples upon request.

GENSEKE BROTHERS



a new way to reduce checking and chalking

• Recent experimental work indicates that TITANOX-RA-NC—a "non-chalking" rutile titanium dioxide pigment—is effective for reducing, not only chalking, but also checking in white-wall tires.

As with all TITANOX pigments, TITANOX-RA-NC is remarkably compatible with rubber compounds and adds long-lasting whiteness and maximum brightness at minimum loading. Write today about your problems in pigmentation of white side wall compounds. Titanium Pigment Corporation, 111 Broadway, New York 6, N. Y.; 104 South Michigan Avenue, Chicago 3, Ill.; 2600 South Eastern Avenue, Los Angeles 22, Calif. Branches in all other principal cities.

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the brightest name in pigments

TITANIUM PIGMENT CORPORATION

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For **MILLS...REFINERS...CRACKERS...CALENDERS...WASHERS**

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Plastics...Tile...Paint...Linoleum and other Non-Metallic Materials

The consistently successful performance of United Rolls results from the greater experience and skill of a corps of highly specialized engineers, metallurgists and seasoned roll makers backed by the unmatched facilities of 6 great plants. These are at your service to meet conventional or special rolling requirements. Consult us. There is no obligation.

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use—

WHITETEX

● **FINE particle size white pigment. Brightness 90-92. GOOD reinforcing. Excellent *processing*.**

» » **SAMPLES SENT PROMPTLY ON REQUEST.** « «

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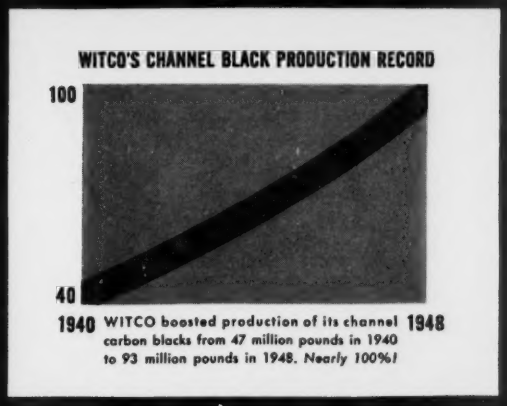
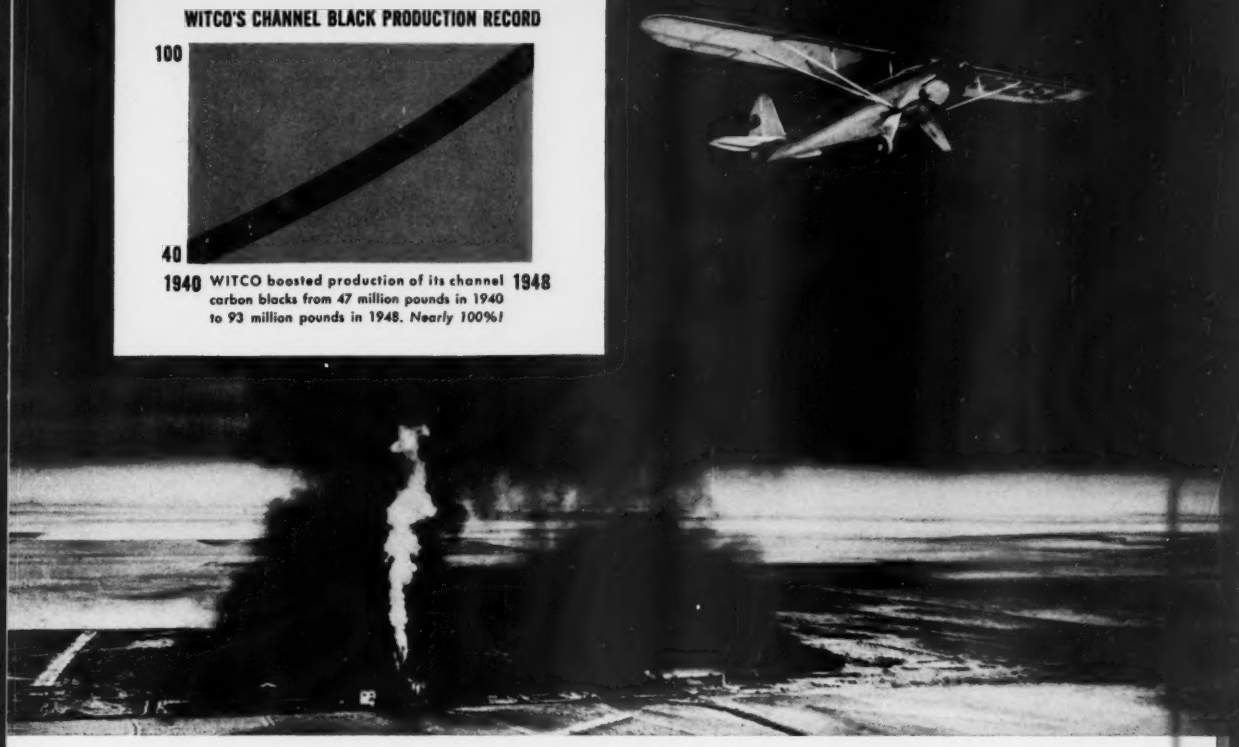

WITCO'S CHANNEL BLACK PRODUCTION RECORD
100
40
1940
1948
WITCO boosted production of its channel carbon blacks from 47 million pounds in 1940 to 93 million pounds in 1948. Nearly 100%!



The burners in **WITCO'S** channel black installations are burning up **production records,** too

As the graph shows, more and more tiny flames, burning day and night, have increased Witco's production of Continental Channel Blacks during 1940 through 1948 from *47 million pounds to 93 million pounds!*

In Continental Channel Blacks, Witco offers a complete, highly specialized line of products for specific needs in all types of rubber compounding—constantly controlled and improved by laboratory and pilot plant research.

Write for samples of WITCO and CONTINENTAL Carbon Blacks for your own staff to evaluate. Or send for complete information.

WITCO CHEMICAL COMPANY

CONTINENTAL CARBON COMPANY

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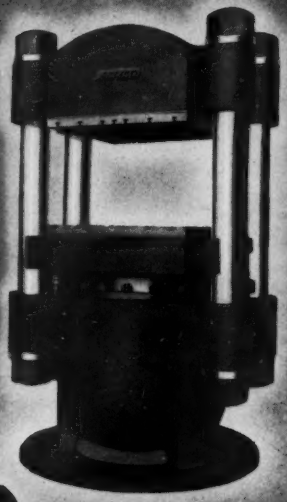

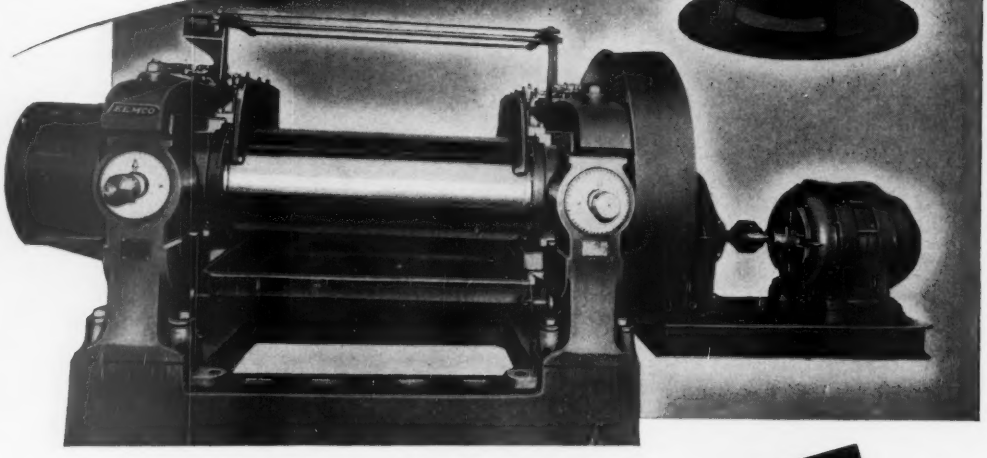

Yes, you will profit, as have many others, if you write to EEMCO for their proposition on Rubber and Plastics Processing Machinery. Engineered right, built right and of best obtainable materials you are assured of longer life and better production when you select EEMCO. If your present or future needs include any of the machines listed below, write EEMCO for a quotation. You will like their attractive prices and quicker deliveries. Standard and custom made, of course.

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RUBBER AND PLASTIC MACHINERY DIVISION

Indonex Plasticizers

REG. U. S. PAT. OFF.

are recommended in the following rubber products – 84% of those in a modern automobile

Battery cases
Battery drain tube
Hood bumpers
Steering post pad
Radiator to hood seals
Water pump seal
Radiator hose
Fender & radiator shields
Lens gaskets
Parking light lens gaskets
Spark plug covers
Ignition wiring
Engine seals & gaskets
Engine front mount
Fan belt
Radiator drain tube
Sway eliminator bushings & cushions

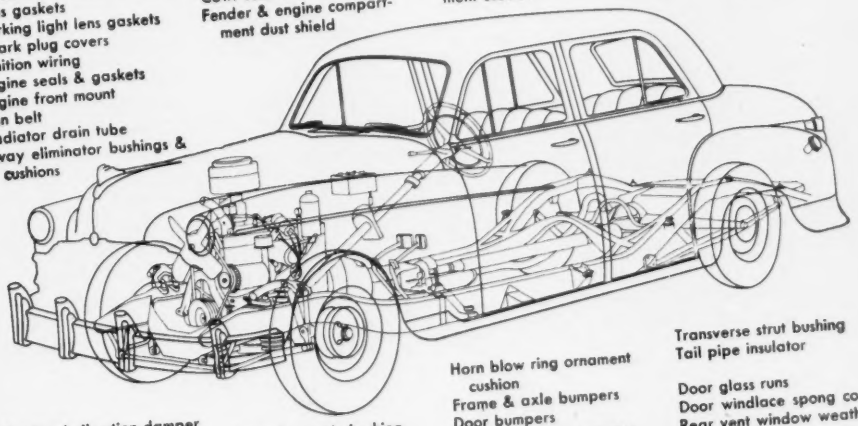
Steering post bracket insulator
Spring silencers
Control arm bumpers

Defroster and wiper hose
Windshield weatherstrip
Windshield wiper pivot pad
Cowl vent weatherstrip
Fender & engine compartment dust shield

Fender flaps
Master cylinder boot & cup
Accelerator-brake-clutch pedal pads
Brake & clutch pedal draft pads

Instrument panel anti squeaks
Steering wheel spoke ornament cushion

Division channel weatherstrip
Door inside locking knob
Hood & door lock seals
Rear deck mat
Tire & tube
Fender seals
Sill mats
Body insulators
Silent bloc bushing
Pinion shaft seal



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Control arm dust seals

Fresh air adaptor grommet
Hood lacing
Glove box door bumpers
Heater hose
Steering collar insulator
Oil line hose
Shock absorber bushings
Steering gear arm insulator bushings

Control arm pin bushing seals
Steering knuckle dust seal
Hydraulic brake hose

Gear shift lever arm bushing
Oil gage hose
Antenna gaskets
Body shims
Transmission & engine rear mount

Horn blow ring ornament cushion
Frame & axle bumpers
Door bumpers
Door check arm bumpers
Dash liner & cowl trim pads
Door hinge post pillar bumper
Floor mats toe riser & trim
Propeller shaft boots

Steering wheel
Front door vent wing weatherstrip

Transverse strut bushing
Tail pipe insulator

Door glass runs
Door windlace spong cover
Rear vent window weatherstrips
Tail & stop lamp lens pads
Tail light mounting pads
Gas tank filler neck grommet
Bumper grommet
Stone deflector bumper
Gas tank shim
Bumper to fender spacer
Spring shackle bushing

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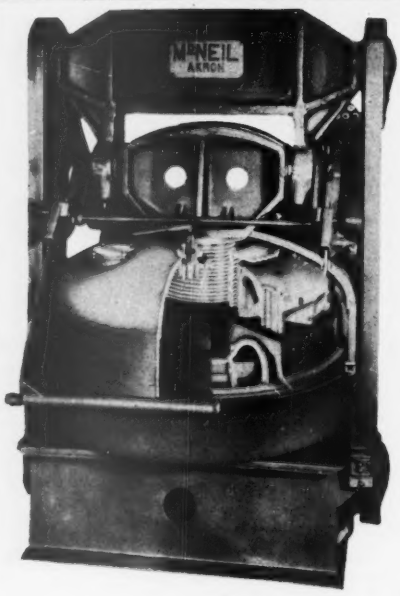
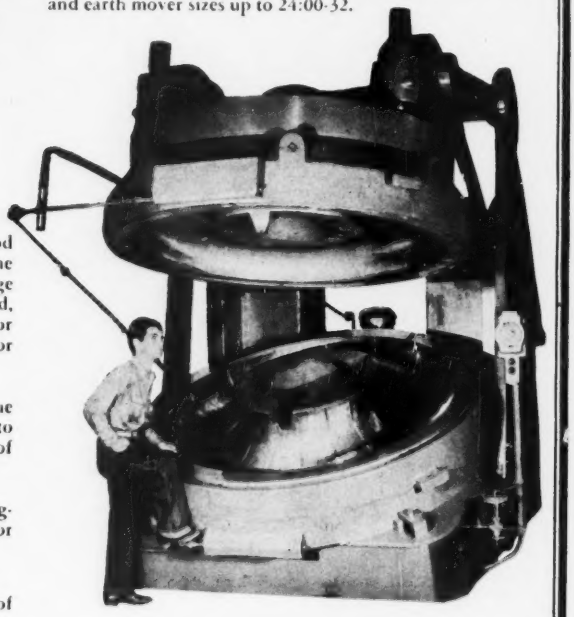


Model 675-65"-18D Single Tire Press

McNEIL

TIRE *and* TUBE CURING PRESSES IN POPULAR SIZES

Model 400 — 75" — 25, shown below, will handle the larger regular truck sizes, plus farm implement sizes and earth mover sizes up to 24:00-32.



Model 400 — 75" — 25 Tube Press

1

Labor and power saving. Our patented method for stripping any size of tire takes most of the work out of the job. One man can operate a large battery of presses. Very little power is required, as our electrically operated unit requires power for only a few seconds during each cycle, to open or close the press.

2

High production, resulting in lower costs due to almost continuous curing. One-half minute to two minutes for changes, depending upon size of tire being cured.

3

Wide range of flexibility and fast mold changing. Simple and rugged design of mechanism for adjustment to suit mold thickness.

4

Better cures, because of open steam method of curing, plus individual temperature and pressure control, plus cooling if desired. All presses are heavy duty type for high internal pressures.

All the experience and engineering skill of the McNEIL organization is at your call to help you increase efficiency and speed while lowering production costs. For tomorrow's production, check with McNEIL today.

MANUFACTURING AGENTS

GREAT BRITAIN—Francis Shaw & Co. Ltd., Manchester, England
AUSTRALIA and NEW ZEALAND—Vickers Ruwolt Proprietary, Ltd., Victoria, Australia.

THE McNEIL MACHINE & ENGINEERING CO.

96 East Crosier St. Akron 11, Ohio

RUBBER WORKING MACHINERY • INDIVIDUAL CURING EQUIPMENT FOR TIRES, TUBES and MECHANICAL GOODS

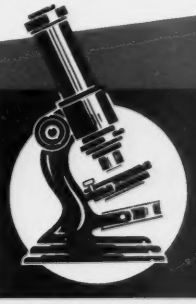
LEADING RUBBER COMPANY
saves 62.4% and 56.4%
ON COLOR COSTS!

A large rubber company, manufacturing an olive drab colored stock, consulted us about the possibility of simplifying the pigment composition—and reducing the color cost.

The rubber company's original formula called for a blend of 5 separate colors—one of them organic. Working from this formula, C. K. Williams & Co. developed two blends of less expensive inorganic pigments. These two blends consisted of 4 colors—and were basically stable, permanent iron oxides.

The recommended pigmentations were checked in the Williams laboratory for perfect color matching—and also for such physical characteristics as tensile strength, tear resistance, and oxygen bomb aging.

Both proved to be satisfactory in all respects—and their costs were 62.4% and 56.4% below that of the combination previously used.



LET WILLIAMS PUT THE MICROSCOPE ON *Your* COLOR PROBLEM

Whatever your color problem, bring it to Williams. As shown by this case history—and many similar histories in our files—Williams can often save you time and money on proper color formulation.

For complete information address Dept. 8, C. K. Williams & Co., Easton, Pa.

WILLIAMS
COLORS & PIGMENTS

C. K. WILLIAMS & CO.

EAST ST. LOUIS, ILL. · EASTON, PA. · EMERYVILLE, CAL.

IRON OXIDES · CHROMIUM OXIDES
EXTENDER PIGMENTS

GEORGIA MARBLE

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CALCIUM CARBONATE PIGMENTS MICROMITE

(–10 MICRONS)

CALWHITE

(–30 MICRONS)

GEORGIA MARBLE CALCIUM CARBONATE PIGMENTS

Offer these advantages:

1. Uniformity of color, particle size, moisture content, packaging—safeguarded by constant control.
2. Unlimited company owned and operated natural resources.
3. Three large New Mills (built post war) with the most modern equipment for producing water ground and air floated, classified calcium carbonate pigments.
4. A milling capacity large enough to fill all orders promptly—regardless of size.
5. A wide range of particle sizes from 200 mesh to minus 10 microns.
6. Mixed carloads at carload prices.

For samples and prices write to

CALCIUM PRODUCTS DIVISION

THE GEORGIA MARBLE COMPANY

TATE, GEORGIA

All-around Accelerator for all rubber goods...

EL-SIXTY

Monsanto El-Sixty* delivers everything you want in accelerator performance whether your product is the most delicate of drug sundries or the most rugged of tires or industrial rubber.

EL-SIXTY OFFERS THESE ADVANTAGES:

- **Safe handling**
- **Versatility**
- **Good performance in white or colored stocks**
- **Ability to wade through retarding pigments**
- **Excellent in pure gum or reclaim stock**
- **Most stable accelerator in latex — causes no thickening in tanks**
- **Can be used alone or activated with Guantal,* Guanidines, Aldehydes, Thiurad,* or Thiurams**

Better give El-Sixty a trial! For information, samples and prices, mail the coupon or write: MONSANTO CHEMICAL COMPANY, Rubber Service Department, 920 Brown Street, Akron 11, Ohio.

*Reg. U. S. Pat. Off.

MONSANTO
CHEMICALS — PLASTICS

MONSANTO CHEMICAL COMPANY
Rubber Service Department
920 Brown Street, Akron 11, Ohio

Please send, without cost or obligation, technical information, prices and sample of El-Sixty.

Name ..... *Title* .....

Company .....

Street .....

City ..... *Zone* ..... *State* .....

SERVING INDUSTRY . . . WHICH SERVES MANKIND

GIANT farm-tractor or off-the-road-tire molds, engraved or of aluminum construction, present no problems to Bridgwater. Special machine tools, many of our own design and make, assure the same precise corners, the same accurate template fit to all characters and ribs in the design, the same highly polished surface characteristic of molds by Bridgwater.

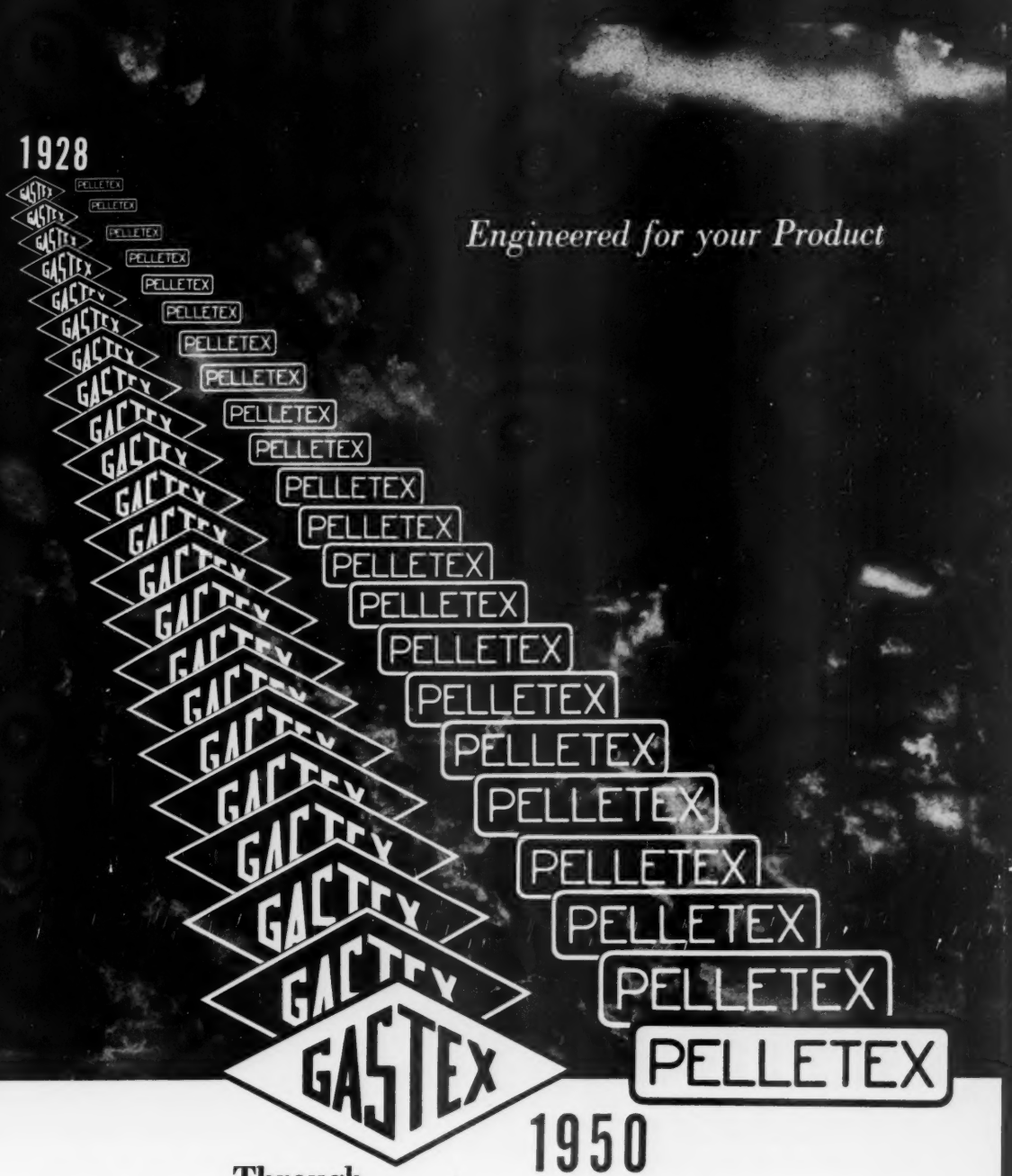
Our new Athens Machine Division, plus enlarged facilities at our Akron plant, enable us to produce quickly molds of any size or type — and at the lowest possible cost.

ATHENS MACHINE DIVISION

THE BRIDGWATER MACHINE COMPANY

Akron, Ohio

FOR BETTER MOLDS FOR BETTER TIRES *SPECIFY* BRIDGWATER



Engineered for your Product

Through The Years Quality CARBON BLACKS

CABOT **The GENERAL ATLAS Carbon Co.**

77 FRANKLIN STREET, BOSTON 10, MASS.

Herron Bros. & Meyer Inc., New York and Akron • Herron & Meyer of Chicago, Chicago • Raw Materials Company, Boston • H. N. Richards Company, Trenton
The B. E. Dougherty Company, Los Angeles and San Francisco • Delacour-Gorrie Limited, Toronto

For INSULATED WIRE, GASKETS and STEAM HOSE

NEW ALBALITH-73

(THE WATER-REPELLENT LITHOPONE)

IMPARTS LOW WATER ABSORPTION

OFFICE OF RUBBER RESERVE *Test Method**		THE NEW JERSEY ZINC COMPANY *Test Method***					
		THICKNESS INCREASE (%)			VOLUME INCREASE (%)		
		Hrs. in H_2O at 70°C.			Hrs. in H_2O at 70°C.		
Pigment	WEIGHT INCREASE (Mg./Sq. Cm.)	300	500	1000	300	500	1000
XX-78 Zinc Oxide	2.49	2.04	3.02	5.74	4.88	6.60	12.52
Albalith-73	2.54	1.95	3.32	6.24	5.15	7.18	13.89
Albalith-11	3.10	2.41	3.76	7.42	6.64	9.00	16.77

COMPOUND

Smoked Sheet	100
Sulfur	3
D P G	1
XX-78 Zinc Oxide	5
Pigment	24 vol./100 vol. Rubber

Cure: 45 minutes @40 lbs.

*Test Method: Section D-3, Determination of Water Absorption, Specifications for Government Synthetic Rubber. Duplicate specimens (2" x 5" x 0.1") of each compound were immersed in water at 70°C. for 20 hours. The increase in weight per unit area represents the water absorption and is expressed in mg./sq. cm.

**This method is similar to the above. Specimens (2" x 2" x 0.1") are immersed in water at 70°C. for the hours shown, and the results are expressed as the increase in thickness and volume.

Albalith-73 is the outstanding lithopone for use in compounds that require low water absorption . . . because it is specially processed, then coated with fatty acids.

Albalith-73, as shown above, imparts about 18% lower water absorption than a typical untreated lithopone.

Albalith-73, moreover, is similar in that feature to XX-78 Zinc Oxide—which for years has been favored for use in insulated wire and other compounds of low water absorption.

Albalith-73 also has good electrical properties, facilitates processing, and imparts high resilience, together with good tensiles and tear resistance.

Take advantage of Albalith-73 in your compounds for insulated wire, steam hose, gaskets and others.

HORSE HEAD PRODUCTS

THE NEW JERSEY ZINC COMPANY

Founded 1848

160 FRONT STREET • NEW YORK 7, N. Y.

CARBON BLACKS

UNITED CARBON COMPANY, INC.

CHARLESTON 27, W. VA.

NEW YORK • AKRON • CHICAGO • BOSTON

Use

UNITED BLACKS

Flames in a channel process plant.

KOSMOBILE 77-EPC
KOSMOBILE HM-MPC

United channel blacks have an enviable record for uniform quality and satisfactory performance. Years of experience and skill govern their manufacture.

United channel blacks are specification-made for use in your rubber, and they are repeatedly and thoroughly quality-checked by us in a number of ways.

United channel blacks are properly pelleted for ready breakdown and dispersion in your mixing and milling equipment.

United channel blacks are dependable for satisfactory processing at all stages and for quick, tight cures.

United channel blacks possess that high reinforcement so essential for the satisfactory performance of your goods in service.

UNITED CARBON COMPANY, INC.

CHARLESTON 27, W. VA.

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DOW CORNING SILICONE MOLD RELEASE AGENTS

PHOTO COURTESY C. F. CHURCH MANUFACTURING COMPANY, PLASTICS DIV. DIV. OF AMERICAN RADIATOR & STANDARD SANITARY CORP.

Your share of the market depends upon your ability to reduce production costs and to improve the quality and appearance of the goods you mold. That's why leading manufacturers in all divisions of the rubber industry are using DC Mold Release Emulsion No. 35A to maintain their dominant position.

Take the C. F. Church Manufacturing Company, for example. At their Monson, Massachusetts plant, DC Mold Release Emulsion No. 35A is used exclusively in molding such parts as the closet seat bumpers shown above. These parts, molded of heavily loaded white stock, are easily removed from multiple cavity molds sprayed with this Dow Corning Silicone release agent. More important, the parts have a flawlessly white and spotlessly clean appearance because DC Mold Release Emulsion No. 35A improves flow and it does not break down to form a carbonaceous deposit on the molds.

Cost is also reduced because rejects due to torn heats and surface blemishes are practically eliminated and mold maintenance is reduced to a minimum.

Investigate **SILASTIC***

The Dow Corning Silicone Rubber for jobs that are too hot or too cold for organic rubbers.

Parts molded of Silastic have thousands of new applications in the aircraft, automotive, process and electrical industries.

*T.M. REG.

DC Silicone Mold Release agents are exceedingly versatile materials for which a wide range of uses have been established in the rubber industry. For more information call any of our branch offices or write for data sheet AE1.

DOW CORNING CORPORATION • MIDLAND, MICHIGAN

Dow Corning
FIRST IN SILICONES

Atlanta • Chicago • Cleveland • Dallas • Los Angeles • New York • In Canada: Fiberglas Canada, Ltd., Toronto • In England: Albright and Wilson, Ltd., London

"DUTCH BOY"
STABILIZERS
for
VINYL RESINS
(Vinyl Chloride Polymers and Copolymers)

Specifically designed to give your vinyl plastics maximum protection against *heat* and *light* aging.

Our technical staff will be glad to help solve your special problems. Write us for complete information.

ADVANTAGES

- Maximum reactive lead content
- Tailored for specific needs
- Widely compatible with other compounding ingredients
- Economical
- Uniform quality

This chart describes some of our products and their uses

TRADE NAME	CHEMICAL COMPOSITION	RECOMMENDED FOR USE IN	USE DATA
"Dutch Boy" Tribase	Tri-basic Lead Sulphate	Electrical compounds	Generally used in combination with DS-207. Works best with organic ester type plasticizers.
"Dutch Boy" Tribase E	Basic Lead Silicate Sulphate Complex	Insulated wire	Lowest volume cost stabilizer especially recommended for electrical compounds.
"Dutch Boy" DS-207	Di-basic Lead Stearate	Sheeting, extrusion and molded compounds, i.e. insulated wire and vinyl phonograph records	Generally used with Plumb-O-Sil B and Tribase. Good for electricals. Adds lubricity and stabilization. Excellent alone as stabilizer and lubricant for rigid vinyl moldings.
"Dutch Boy" Plumb-O-Sil A	Co-precipitate of Lead Orthosilicate and Silica Gel	Sheeting and upholstery stocks	Easy processing. Gives a high degree of translucence.
"Dutch Boy" Plumb-O-Sil B	Co-precipitate of Lead Orthosilicate and Silica Gel	Translucent film and sheeting, belting	For translucent compounds and bright colors, minimizes spewing.
"Dutch Boy" Plumb-O-Sil B Electrical Grade	Co-precipitate of Lead Orthosilicate and Silica Gel	Insulated wire	Low volume cost, excellent electrical characteristics.
"Dutch Boy" Dythal	Di-basic Lead Phthalate	Electrical stocks and opaque films	General purpose stabilizer for heat and light.
"Dutch Boy" Dyphos	Di-basic Lead Phosphite	All opaque stocks including Plastisols and Organosols	Excellent for heat and light with organic ester and polymeric type plasticizers; anti-oxidant stabilizer; useful with chlorinated paraffin extenders. Generally used with DS-207.
"Dutch Boy" Normasal	Normal Lead Salicylate	Vinyl flooring compounds. Rubber stocks as non-scorch activator	Useful in small amounts with phosphate type plasticizer. Antioxidant stabilizer.

"Dutch Boy" CHEMICALS

NATIONAL LEAD COMPANY, 111 Broadway, New York 6, N. Y.

Reds

CADMOLITH COLORS

Yellows!

- INSOLUBLE IN ALL VEHICLES
- SOFT AND EASY TO GRIND
- BRIGHT CLEAR COLORS
- NON-FADING TO LIGHT
- ALKALI RESISTANT
- ACID RESISTANT
- HEAT RESISTANT
- NON-SETTLING
- NON-BLEEDING
- OPAQUE

With a combination of advantages found in no other red or yellow pigments—the direct result of Glidden leadership in research—Glidden Cadmolith* Colors are now adding new sales appeal and lasting beauty to an amazing variety of products . . . All shades available for prompt shipment!

Send for Folder giving complete details, with color chips. Write The Chemical & Pigment Company, division of The Glidden Company, Union Commerce Building, Cleveland 14, Ohio.

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QUALITY Glidden PRODUCTS

THE CHEMICAL & PIGMENT COMPANY
Division of
THE GLIDDEN COMPANY
Baltimore, Md. • Collinsville, Ill. • Oakland, California

SUNOLITH*	ASTROLITH*	ZOPAQUE*	CADMOLITH*
Lithopone	Lithopone	Titanium Dioxide	Cadmium Red and Yellow Lithopone

SUN "JOB PROVED" PRODUCTS CUT COSTS,

Sun products have been "Job Proved" in the lubrication of almost every type of mining, manufacturing, power, and transportation equipment . . . in refrigeration and air-conditioning . . . in metal cutting, tempering, and quenching . . . in the processing of textile fibers, leather, natural and synthetic rubbers . . . in the impregnation of electrical, electronic, and packaging materials of many kinds.

To help you solve your production problems, Sun Oil Company offers a wide selection of "Job Proved" petroleum products, plus the experience of Sun Engineers. Their know-how and detailed product information are yours for the asking. Call your local Sun office, or write Dept. RA-1.

SUN OIL COMPANY • PHILADELPHIA 3, PA.

In Canada: Sun Oil Company, Ltd., Toronto and Montreal

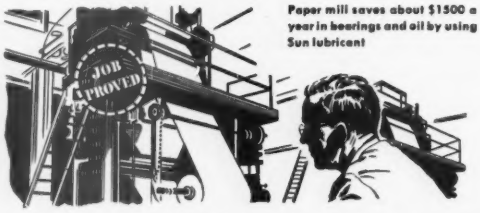
INDUSTRIAL OILS

SUNVIS 900 OILS—High-viscosity-index, paraffinic-type oils—of uniform O F pour point—fortified against rust, corrosion, oxidation, and sludge. The finest available lubricant for turbines, hydraulic systems, and similar applications.

SUNVIS HD 700 OILS—High-viscosity-index oils containing additives which minimize oxidation and give detergency. Ideal lubricants for internal combustion engines subjected to continuous heavy loads under the most adverse conditions.

SUNVIS OILS—Solvent-refined paraffinic-type oils of uniform high viscosity index, low pour point, and low carbon content. Especially suitable for application to long-time use in all types of industrial reservoirs and circulating systems.

DYNAVIS OILS—Low-pour-point, high-viscosity-index, inhibited oils, containing an additive which helps prevent formation of harmful corrosive and sludge-forming acids. Well suited for engines fitted with alloy bearings and operated at high temperatures.



Paper mill saves about $1500 a year in bearings and oil by using Sun lubricant

SOLNUS OILS—Well-refined straight mineral oils. Stand up under hard use for long periods of time. Recommended for use in machine tools, air compressors, certain types of diesels, etc.

CIRCO OILS—Used for general lubrication of industrial machinery when straight mineral oils are required.

SUNTAC OILS—100%-petroleum products which have been compounded to increase their adhesiveness. Recommended for general lubrication of all machines subjected to sudden shocks and load reversals. Cling to the parts to be lubricated.

STEAM CYLINDER OILS—High flash and fire point lubricants for either saturated or superheated steam conditions and for worm-gear speed-reduction units.

SUN CAR JOURNAL OILS—Dark oils meeting A.A.R. Specifications. For use in waste-packed bearings of railroad equipment.

SUN DELAWARE OILS—Dark oils for general lubrication on older types of industrial machinery.

SUNOCO WAY LUBRICANT—For use on tableways. Eliminates chatter and scoring . . . resists corrosion. Has good metal-wetting and adhesive properties, ample viscosity, and E. P. qualities.

SUN MARINE ENGINE OILS—Compounded with special emulsifying agents in order to provide adhesion to, and lubrication of, working parts in the presence of water. For the lubrication of bearings, eccentrics, crossheads, and various other parts of steam engines.

ROCK DRILL OIL—High-film-strength adhesive oil. For use in jackhammers, stopers, drifters, and similar equipment.

INDUSTRIAL GREASES

SUN CUP GREASES—Water resistant. For grease-cup and grease-gun application when service is normal.

SUN GUN GREASES—Smooth greases made with medium-viscosity oil. Stable under pressure in power and booster guns.

ADHESIVE PRESSURE GREASES—Won't drip or splash. Excellent lubricants for open-gear applications.

SUN DARK PRESSURE-SYSTEM GREASES—For power-driven central grease lubricating systems in heavy industries. Also used as a "medium cup grease."

SUN MINE CAR GREASES—Available in several grades. Suitable for both antifriction bearings and plain-bearing cavity-type wheels.

SUN MINING MACHINE LUBRICANT—Semifluid. For use where a light but adhesive grease is required. Resists separation and decomposition.

Chemical plant saves about $8000 per year by adopting Sun Pressure Grease

SUN ROLLER BEARING GREASES—For use on electric motors and generators and high-temperature machinery equipped with ball or roller bearings.

SUN GEAR COMPOUNDS—Black adhesive open-gear compounds and

"JOB PROVED" IN EVERY INDUSTRY

SUN PETROLEUM

SPEED PRODUCTION, IMPROVE QUALITY

wire-cable greases. Recommended for power presses, mining machinery, worn reduction mills, crushers, pump gears, etc.

SUNOCO TRACTOR ROLLER COMPOUND—For crawler-type tractors. Provides good lubrication with exceptional sealing qualities.

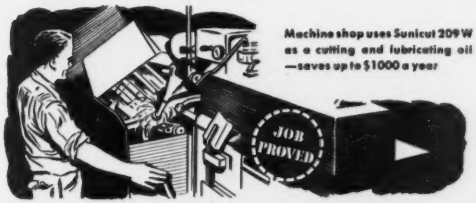
METALWORKING OILS

SUNICUT—Straight (non-emulsifiable) transparent cutting oils. Recommended for automatic screw machines and heavy-duty machining operations. Permit high speed production with excellent finishes, long tool life.

SUNOCO EMULSIFYING CUTTING OIL—A self-emulsifying oil which produces a stable white emulsion. Efficient and economical cooling and lubricating medium for turning, milling, drilling, and other metalworking operations on both ferrous and nonferrous metals. It is also an excellent grinding coolant.

SUN QUENCHING OILS—Specially refined oils designed to aid development of maximum physical properties in a wide variety of steels.

SUN TEMPERING OILS—Specially refined oils for tempering steel. Because of their low carbon content and stability under heat, these oils have an unusually long service life.



Machine shop uses Sunicut 209W as a cutting and lubricating oil—saves up to $1000 a year

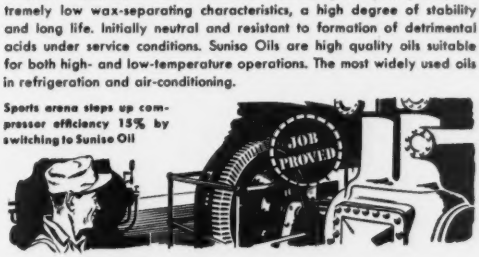
SUN ROLLING OILS—Straight and emulsifying oils which will permit maximum production in rolling steel, aluminum, brass, and copper.

SUN ANTI-RUST COMPOUNDS—Petroleum-base oils with chemical additives designed to prevent the rusting and corrosion of steel.

REFRIGERATION OILS

SUNISO REFRIGERATION OILS—Have extremely low pour points, extremely low wax-separating characteristics, a high degree of stability and long life. Initially neutral and resistant to formation of detrimental acids under service conditions. Suniso Oils are high quality oils suitable for both high- and low-temperature operations. The most widely used oils in refrigeration and air-conditioning.

Sports arena steps up compressor efficiency 15% by switching to Suniso Oil



TEXTILE-PROCESSING OILS

SUNOTEX TEXTILE OILS—Designed to impart certain additional properties to various forms of fibers during their processing from the fiber state into a manufactured product. All Sunotex textile oils are emulsifiable in water. Highest rating in fadometer tests.

SUN COTTON CONDITIONING OILS—Pale mineral oils which condition the cotton. They prevent waste by cutting down excessive amounts of "fly" (fine air-borne lint particles).

Worsted mill obtains easier scouring, better quality, larger yield with Sunotex WO-220

SUN ASBESTOS FIBER CONDITIONING OIL—Used for spraying on the asbestos during processing. Fibers are kept from being damaged or broken down, and harmful dust is minimized when this product is used.

SUN CORDAGE OILS—Generally used alone, but are adaptable to various formulas used by cordage manufacturers. Selected products, highly compatible with additives.

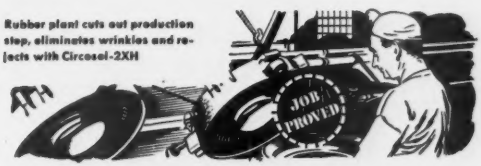
RUBBER-PROCESSING AIDS

CIRCOSOL-2XH—An elasticator and processing aid for natural rubber and especially for GR-S. Outstanding for sponge rubber.

CIRCO LIGHT PROCESS AID—A processing agent and excellent softener for natural rubber, natural rubber reclaims, and neoprene synthetic rubber. Used for GR-S to some extent.

SUNDEX-53—An inexpensive product suitable for processing GR-S and blends of GR-S and natural rubber. An established processing aid for rubber footwear stocks and semihard rubbers.

Rubber plant cuts out production step, eliminates wrinkles and rejects with Circosol-2XH



CIRCOMAR-5AA—A black-colored product for processing natural and GR-S rubber used in tire-making. Also used in reclaiming natural-rubber scrap. Replaces asphalt fluxes. Free-flowing at room temperature.

WAXES

Sun's new wax plant was completed in 1949. Its many refining innovations and extreme flexibility permit new types of waxes to be manufactured in large quantities—a procedure heretofore impracticable. A wide range of fully refined paraffin and microcrystalline waxes will be "tailor-made" to meet the requirements of virtually all major industrial applications. Pilot plant samples of several grades are now available.

MISCELLANEOUS INDUSTRIAL PRODUCTS

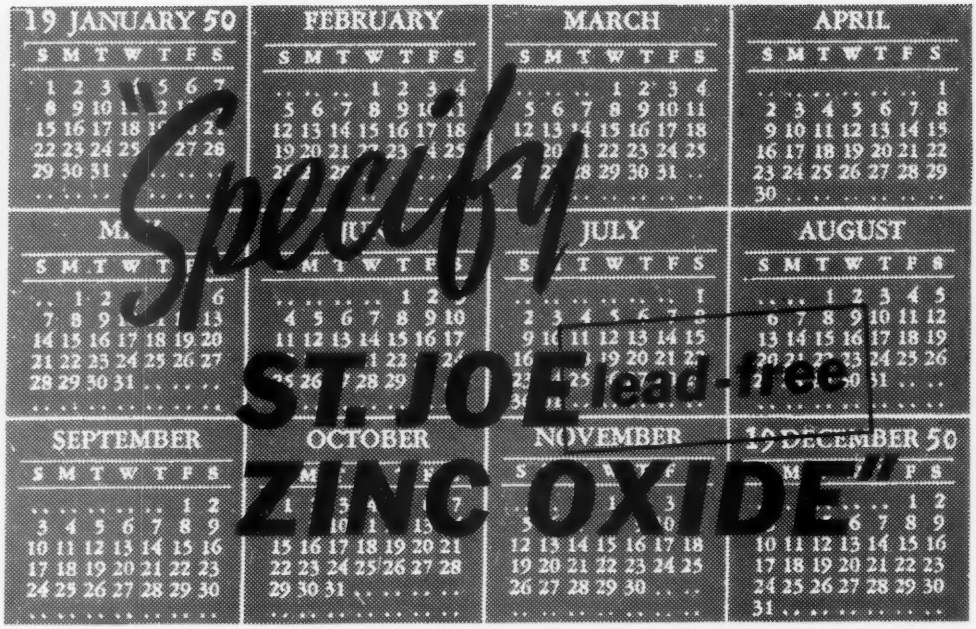
SUN SOLVENTS—Sun Spirits for the thinning of paints, varnishes, and enamels, and for metal-cleaning . . . a pure, water-white petroleum solvent free of corrosive sulphur. Other Sun solvents with special properties are available for the chemical industry.

SUN LEATHER OILS—Mineral-base leather oils. Used for obtaining the desired tensile strength, proper temper, and controlled moisture content. Maintain a light even color . . . mix well . . . distribute evenly.

"JOB PROVED" IN EVERY INDUSTRY

PRODUCTS SUNOCO

A New Year's Resolution readily kept and perpetuated:



Year after year, many of the country's substantial consumers specify ST. JOE ZINC OXIDES as a matter of course. While behind the preference thus indicated may be a variety of individual and specific reasons, their sum and substance can be expressed in plain, elementary language as follows:

The *consistent* high quality of St. Joe zinc oxides makes their continued use in the rubber, paint, ceramic and other industries a matter of sound business procedure.

ST. JOSEPH LEAD COMPANY *250 PARK AVENUE, NEW YORK 17, ELDORADO 5-3200*
Plant & Laboratory, Monaca (Josephtown) Pennsylvania

House of New Ideas

FOR PRODUCTS AND SALES

Flintkote employs experienced technicians... Research Specialists who spend every working day tracking down new facts on materials and methods that can improve or broaden Flintkote's wide line of products for industry.

Housed in 24 separate, efficiently equipped laboratories... in one of the most modern buildings in the country... these technicians set the pace for Flintkote plants from coast to coast. This assures better products and better results consistent with lowest possible costs ... for you.

These researchers understand what makes business "tick," too. And they accept new product requirements as a recurring challenge. Also, the quality of our materials that have been in use for decades is carefully checked for today's applications.

So, if you are a user, or a potential user of Flintkote Industrial Products for construction, manufacturing or converting, remember that these trained specialists are at your service, to help find the solution to your problems. Full scale testing and pilot production methods are available under one roof. And, they'll follow through in your own plant if you wish.

Whether your requirements are coatings, adhesives, binders, floorings... asphalt, rubber or resin compounds... Automotive, Marine, Railroad, Construction, Building Maintenance products... see what we have now and can offer you for the future.

THE FLINTKOTE COMPANY

Industrial Products Division

30 Rockefeller Plaza, New York 20, N. Y.

Atlanta • Boston • Chicago Heights • Detroit • Los Angeles
New Orleans • Washington • Toronto • Montreal

Testing effective coverage of asphalt coatings. The metal plate with coating is grounded and a charge is placed in the metal bristles of the brush. Even the smallest rupture in the film produces a visible spark, indicating incomplete protection.

Among Flintkote's many products is a line of asphaltic spray-on sound deadeners to quiet metal vibration noises. In a specially-built sound-proof room, an electronic device measures the ability of various coatings to meet rigid specifications.

Summer and Winter climate, rain and burning heat are produced in the Research Laboratory. This Twin-Arc Weather-Ometer provides accurate control of accelerated weathering tests. Products designed for exposure must survive for many years.

This small mill is used to break down various rubber materials to the right consistency for use in new products or processes. Full size operation follows in the production of versatile fluid rubber and rubber-like adhesives, coatings and the like.

FLINTKOTE INDUSTRIAL PRODUCTS

FLINTKOTE

Products for Industry

Available Now

"Proceedings of the 1948 Rubber Technology Conference"

This volume contains copies of the 43 papers presented at the Conference held in London, June 23-25, 1948, under the auspices of the Institution of the Rubber Industry, and includes the discussion on each paper. The papers are world-wide in character and represent the latest thinking in the science and general technology of rubber as reported by the rubber industry's leading technologists.

TITLES OF PAPERS

Synthetic Rubbers

Silicone Rubber—A New Synthetic Elastomer. *S. L. Bass.*
Comparisons of Natural and Butadiene-Styrene Rubbers. *J. H. Fielding* and *R. P. Dinsmore.*
Low Temperature Performance of Butyl Inner Tubes. *R. J. Adams, E. J. Buckler,* and *G. G. Wanless.*
Preparation and Properties of Buna N Type Copolymers. *J. F. Nelson* and *B. M. Vanderbilt.*
Some New Compositions based on Condensation Rubbers. *D. A. Harper, W. F. Smith,* and *H. G. White.*
Alteration of Neoprene by Polymerisation Temperature. *H. W. Walker* and *W. E. Mochel.*

Chemistry of Rubber

Nature of the Sulphur Linkages in Rubber Vulcanisates. *G. F. Bloomfield.*
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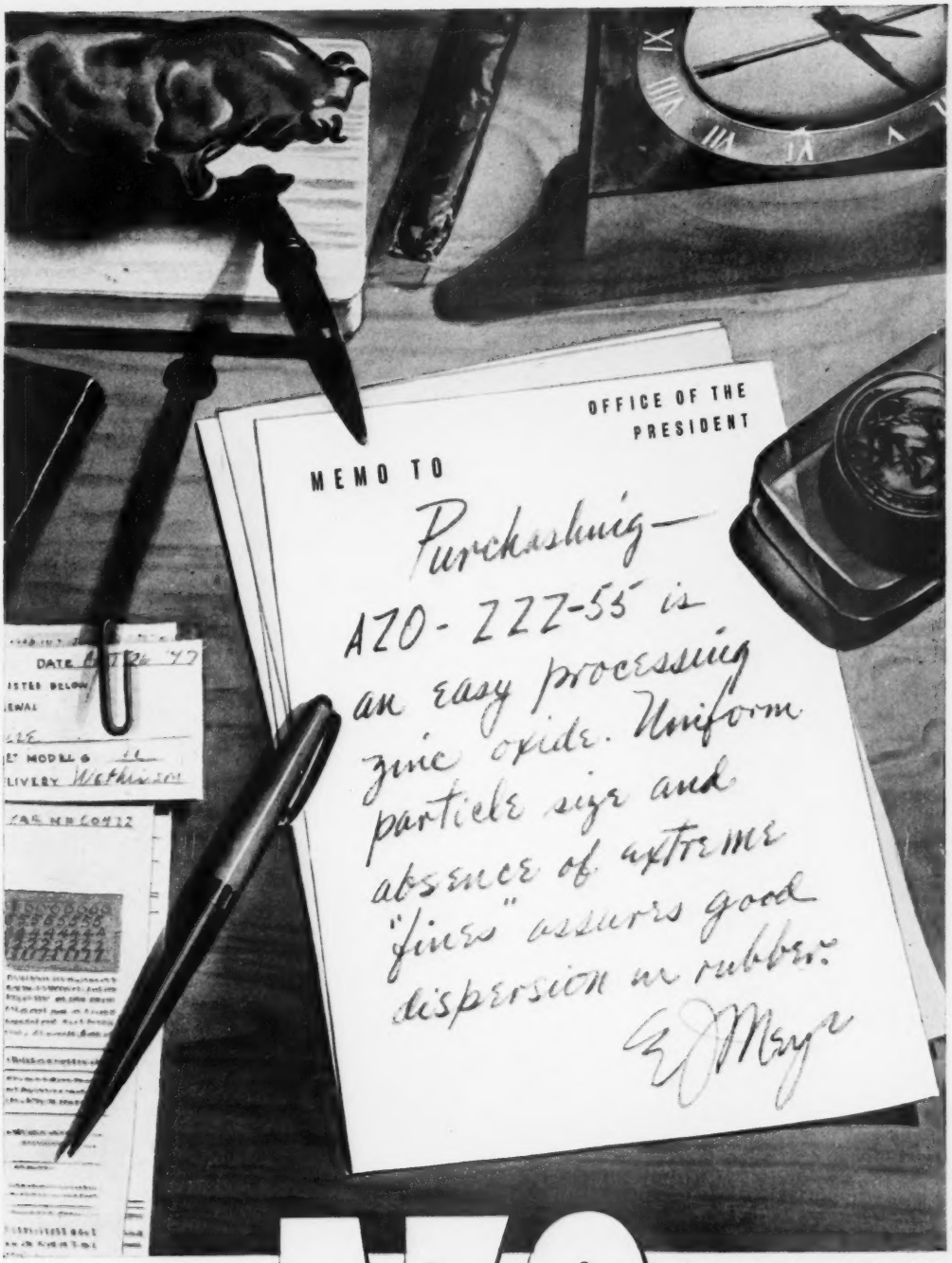

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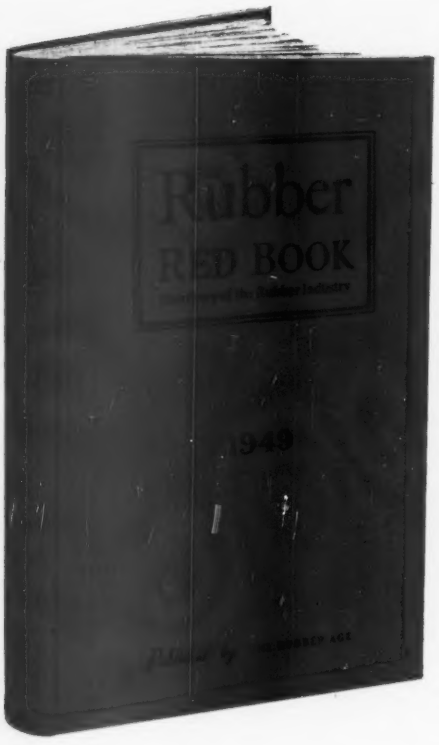

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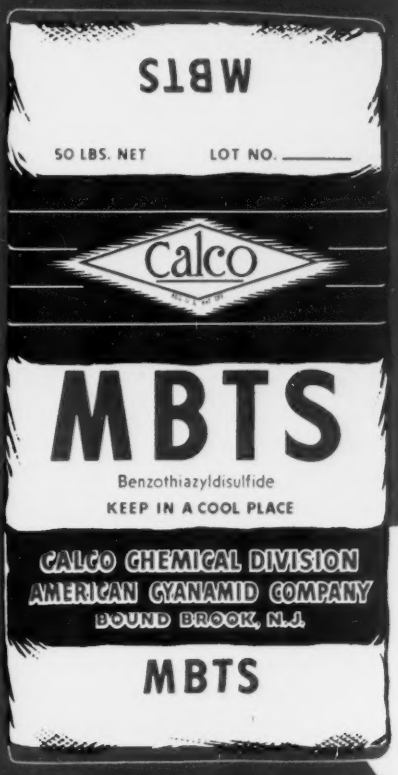

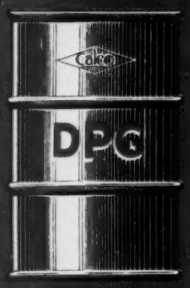

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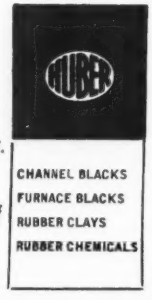

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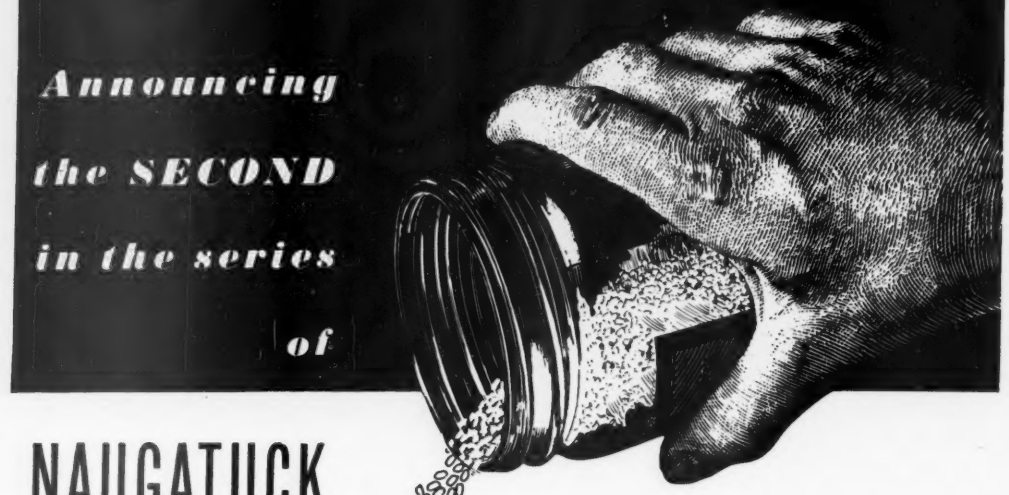

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Water Impermeable-Water Vapor Permeable Coated Fabrics

By GEORGE E. MARTIN[1], HAROLD S. SELL[2], and BRUCE W. HABECK[2]

THE limitations of rubberized coated fabrics, plastic films or plastic coated fabrics for use in rainwear apparel have long been recognized. While such materials afford effective protection from the rain, their very limited ability to transmit body perspiration away from the wearer results in the problem of heat build-up on the inside of the impermeable garment with resultant sweating and chilling. The following discussion deals with the research work, and laboratory and field testing involved in the development of the coated fabric to meet this need.

Background

Exploratory studies by C. L. Woodworth *(1)* at the Quartermaster Climatic Research Laboratory, Lawrence, Mass., were carried on to determine the limits of water vapor permeability necessary in a fabric for comfort. His work showed that in order for a water impermeable-water vapor permeable fabric to be practical its ability to transmit moisture vapor would have to closely approach that of an uncoated fabric. As a result, the first attempts to produce a water impermeable-water vapor permeable fabric centered around the improvement of the water resistance of the various water repellent treated fabrics.

Extensive work showed this line of attack to be difficult. While excellent moisture vapor transmission rates could be obtained with this type of treatment, no successful method could be found to develop a hydrostatic head of 75 cm. of water at the same time. This hydrostatic head, held for five minutes on the Suter Hydrostatic Head Tester, is the minimum requirement for waterproofness.

Having exhausted the possibilities in the above line of attack, the next approach seemed to be to develop into the waterproof rubberized coatings the property of moisture vapor transmission. It was immediately recognized that in order to achieve this end, it would be necessary to incorporate into the coating channels which would transmit moisture vapor. To accomplish this, without destroying the waterproofness, presented a most difficult problem. Mechanical or electrostatic perforation of the coated fabric destroyed the waterproofness while only improving the fabric's ability to transmit moisture vapor slightly.

The first theory developed as a means of transmitting moisture vapor through a rubberized fabric was the incorporation into a rubber matrix of a porous pigment in such a manner so that the pigment particles would touch each other. This would allow moisture vapor transmis-

[1] Chemicals and Plastics Section, Quartermaster Research Laboratories, Washington, D. C.
[2] Chemical Products Development Division, Goodyear Tire & Rubber Co., Akron, Ohio.

Note: The opinions expressed herein are those of the authors and are not to be construed as the official view of the Quartermaster Corps or the Department of the Army.

TABLE I—COMPARISON OF WATER IMPERMEABLE-WATER VAPOR PERMEABLE FABRICS WITH RUBBERIZED AND WATER REPELLENT FABRICS

	Moisture Vapor Trans. % of That Transmitted by Base Fabric	Hydrostatic Head cm. Water ASTM Test [a]	Suter Test [b]
Water Repellent Fabric	100	——	10–50
Rubberized Fabric	0–10	300+	278+
Treated Porous Pigment—Latex Binder	25	200	——
Untreated Porous Pigment—Latex Binder	42	250	——
Untreated Porous Pigment—Solvent Cement Binder	58	250	——
Solid Pigment—Solvent Cement Binder	73	300+	278+

[a] Fifth drop through a 3.12 in.² area. [b] First drop through a 15.9 in.² area.

sion through the coating from particle to particle of the pigment. In further development of the theory, a number of porous pigments were studied. Consideration was given to such properties as low density, low thermal conductivity, fireproofness, and mildew resistance.

The porous pigment finally selected had all of the above properties but was highly hydrophilic. Since it was planned to use a rubber latex as a binder, it was known that this highly hydrophilic pigment would coagulate the latex. In addition, a hydrophilic pigment in an open coating would absorb relatively large quantities of water. Therefore, a silicone treatment was added to the pigment, making it hydrophobic, and this treated pigment was then incorporated in the rubber latex. Coated fabrics were produced on a Tenter Frame Spreader and showed some measure of moisture vapor transmission.

Attempts were made to measure the air permeability of these moisture vapor permeable fabrics *(2)*. The values obtained were below the lower limit of such conventional apparatus as the Gurley Densometer or the Frazier Permeameter. Because relatively high rates of moisture vapor transfer had been obtained on these fabrics, it was concluded that there was no relation between air permeability and moisture vapor permeability on this type of fabric.

The development of a water impermeable-water vapor permeable fabric having shown some promise, a research contract was let with the Chemical Products Development Division of the Goodyear Tire & Rubber Company.

After experiments with various latices and production procedures, coated fabrics were produced on large scale equipment using the silicone-treated porous pigment and a synthetic rubber latex. Since these coated fabrics had relatively low rates of moisture vapor transfer when compared to uncoated fabrics, it was deemed necessary to conduct comfort tests to determine whether further work was warranted. Garments were constructed and sent to the University of Indiana for test.

During these tests, conducted by S. D. Gerking and Sid Robinson, of the Department of Physiology, Indiana University Medical School *(3)*, to determine the heat stress imposed by impermeable wet weather suits and the experimental water impermeable-water vapor permeable suits, the relative coolness of the following four types of clothing were compared:

1. Poplin jungle uniform.
2. Wet weather suit with permeable coating.
3. Wet weather suit laminated with permeable coating.
4. Impermeable wet weather suit.

All of the wet weather garments were made in the same design.

The experiments were performed on men walking on a treadmill at a metabolic rate of 190 Cal./M² per hour. The subjects used in the tests were all well acclimatized to the heat and maintained water balance during the two-hour experiments by drinking measured quantities of 0.1 percent salt solution. The wet weather suits were worn by the men in four different environments: air temperature 17.4°C. with 57% R.H., 24.1°C. with 50% R.H., 30.5°C. with 80% R.H., and 37.9°C. with 29% R.H. The latter environment was used to determine the maximum rate at which sweat could be evaporated from the clothing. In addition to the suits the subjects wore shorts, shoes, and socks in each experiment.

In all the two-hour experiments, the clothed and nude weights of the men were determined hourly in order to follow their rates of sweating and evaporation. The skin temperature of the men was measured at 15 minute intervals by four thermocouples placed separately on hip, chest, shoulder, and knee. Rectal temperatures were measured every half hour with a clinical thermometer, and heart rates were recorded at 15 minute intervals by an electrocardiotachometer. At air temperatures of 24.1°C., and 30.5°C., the comparisons of the clothing consisted of two experiments in which two men walked on the treadmill simultaneously.

In these studies, each subject wore each type of garment being considered. The data of both men for each type of garment were averaged to offset variations in the environment and the performance of the men from day to day. At 17.4°C. and 37.9°C., four subjects wore four different types of clothing in only one experiment each; thus, no direct comparison of the garments was obtained in these environments.

The water impermeable-water vapor permeable suits had a distinct advantage in a hot dry environment (37.9°C., 29% R.H.) where a high rate of evaporation was required. The subject who wore the impermeable suit under these conditions was barely able to complete one hour of work, while the subject who wore the water impermeable-water vapor prmeable suit was not taxed to complete two hours of the same work. Based on the rates of sweating, skin temperatures, rectal temperatures, percent of sweat evaporated, and heart rates of the men in all environments, the clothing was classified as to relative coolness in the following order:

1. Poplin jungle uniform.
2. Wet weather suit with permeable coating outside.
3. Wet weather suit laminated with permeable coating.
4. Impermeable wet weather suit.

These tests on water impermeable-moisture vapor permeable fabrics conclusively proved that the moisture vapor transmission rate was sufficiently great to be of practical value for specific application.

While the treated porous pigment-synthetic rubber latex combination did result in a coated fabric which was water impermeable and water vapor permeable, as shown by laboratory and comfort testing, the coating itself had many features which were objectionable from a processing and physical property standpoint. Because the basic spreading material was a water dispersion, difficulties were encountered with drying, shrinkage of fabrics, and corrosion of equipment. In addition to being costly and difficult to control, the coating was of an extremely weak nature. Extensive work resulted in

limited progress in overcoming these difficulties. It became evident that new approaches would have to be investigated.

Concentrated effort soon brought about a number of entirely new concepts on the problem. A naturally occurring porous pigment was found which could be successfully used without the necessity of a water repellent treatment. Since the solubility of the silicone treatment had previously limited the binders to latices, this finding opened the possibility of the use of solvent rubber cements as binders. This meant that not only could the costly treatment be eliminated, but the coating material would lend itself to conventional rubber spreaders.

The porous pigment-rubber cement combination was successfully reduced to practice. Coated fabrics, which had excellent properties when compared with those of the treated pigment-rubber latex type, were produced on large scale equipment. While this coating was a marked improvement over the previous product, a number of necessary properties were still lacking. It lacked the required strength, possessed less than satisfactory aging characteristics as measured on the Weather-Ometer, and it failed to withstand washing and/or dry cleaning.

During the course of these investigations, experiments were undertaken using a solid pigment with a rubber cement, and it was discovered that a water impermeable-water vapor permeable fabric could be made with this combination. It was eventually demonstrated that this coating functioned by means of a complicated, three-dimensional interconnected structure of micropores. Since this last approach had produced a coated fabric which had the most reproducible and satisfactory physical properties of the various coatings tried, its theory will be considered in more detail. It was work on this concept which finally produced the coated fabric presently developed to a usable stage.

While the early stages of this development have been discussed somewhat briefly, they do represent tremendous strides toward the development of a water impermeable-water vapor permeable fabric. This can be clearly seen from an examination of the data in Table I.

Discussion

Theory

In order to obtain a porous coating using a solid pigment and rubber, an entirely different approach was used than has been normally recognized in this field. Using a solid pigment means that the pores have to be developed around the pigment in the coating upon drying. It is a known fact that because of their particle size and shape, pigments occupy much larger volumes than their true specific gravity indicates. This is true even under wetted centrifuged conditions and suggests that there is some void space between the pigment particles. If it is possible to add rubber to the pigment in such a volume as to bind the pigment particles together without occupying all of the void space available between the wetted packed particles, then it is possible to produce pores with the remaining void space upon drying the coating.

This theory might be more easily understood by considering an example: One hundred grams of a pigment having a specific gravity of 2.70 were found to occupy 127 cc. under wetted centrifuged conditions. Based upon its true specific gravity, 100 grams of this pigment should occupy only 37 cc. This would mean that 90 cc. of void space occurs between the pigment particles; this space would be available for binder and pores. If 50 cc. of binder were used to bind together the 100 gms. of pigment, then there would be 40 cc. of void space in the coating. On a percentage basis, this would mean that 31.5% of the coating would be voids.

A large number of pigments were examined under wetted centrifuged conditions. In some pigments, the available void space was considerably larger than in others. In fact, various grades of the same pigment were found to have extreme variation in the void space available. Knowing this, and considering the above theory, it could be seen that the pigment particle size and particle shape greatly influence both the number and the size of the pores developed.

It could then be visualized that a given volume of void space could be accomplished either by the production of a large number of small pores or by the production of a small number of large pores depending on the choice of the pigment. Producing and studying actual coatings was the only way to determine if this was true.

A large number of pigments and rubber binders were tried in varying ratios of pigment to binder. These blends were coated upon a base fabric and some of the resulting coatings were studied under a microscope. Figure 1 is the result of surface microscopic examination of these coated fabrics. It will be noted from the curve that in this type of coating, as theorized, the number of pores per square centimeter increases as the size of the pore decreases. Having established the existence of a wide variation of pore size and number within the sample coatings, it was most interesting to study the moisture vapor transfer and hydrostatic head resistance of these same coatings. Figure 2 indicates that moisture vapor transfer is obtained so long as a sufficient volume of pores is present, whether the pores be large or small. However, a trend could be noted toward a higher moisture vapor transfer in those coatings having a large number of small pores.

While the moisture vapor transfer was not influenced too greatly by the pore size, such was not the case with the hydrostatic head property. Examination of Figure 3 clearly indicates a steady increase in the hydrostatic head resistance as the pore size decreases. This graph also shows no appreciable increase in hydrostatic head until a pore size under 30 microns is attained. This ex-

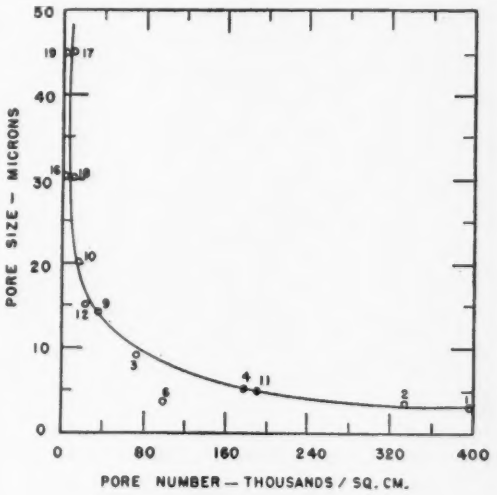

FIG. 1—Pore Number vs Pore Size.

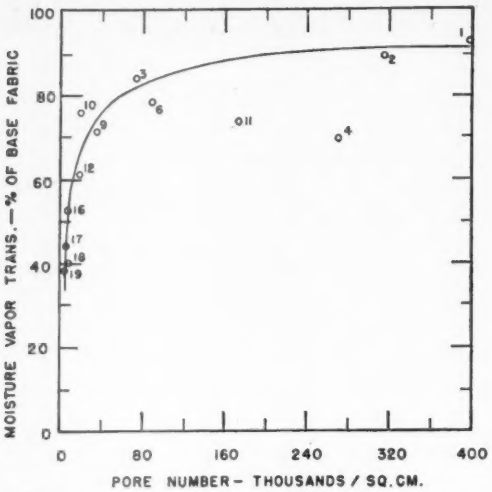

FIG. 2—Pore Number vs Moisture Vapor Transfer.

plains the probable reason for the loss in hydrostatic head resistance in the mechanically or electrostatically perforated coated fabrics.

Having established the requirements necessary to obtain a high rate of moisture vapor transfer as well as excellent hydrostatic head resistance, the task remained to select the pigment best suited for the job. It will be noted, in observing the graphs, that each point as plotted is represented by a number. These numbers correspond to the pigment used in producing the coating, so that the point labeled (10) on each of the graphs, represents properties obtained with a given pigment and resultant coating. Close observation of these graphs will indicate that some pigments produce more desirable properties than others. For instance, pigment (11) produced a good moisture vapor transfer, but a relatively low hydrostatic head resistance, while pigment (19) produced a low hydrostatic head resistance and a low rate of moisture vapor transfer. However, a number of pigments (1), (2), (3), (4), and (6) produced coatings which had hydrostatic head readings over 200 cm. of water and moisture vapor transfer values of over 60% of the transmission rate of the base fabric. It will be noted that all these coatings contained surface pores of under 10 microns in diameter, although the number of pores varied widely.

While the good results obtained on pigments (3), (4), and (6) might seem contradictory to the theory because of the small number of pores present, an explanation was found when the dissected coating was examined under the microscope. The accompanying photomicrograph (Figure 4) shows that the inner structure of the coating is not one of vertical pores, but rather is made up of a complicated structure of interconnected three-dimensional pores. Observation of the coatings indicated that this type of interconnected pore was much more prevalent in those coatings having the small-sized pores. Thus, through this interconnection within the coating, it was possible to transmit moisture vapor at a high rate even though there were wide variations in the number of surface pores.

Since a number of pigments were found which gave the desirable properties in this type of coating, the actual selection of the pigment was based on reproducibility on large scale equipment, cost, ease of handling in the process, and the resulting physical properties of the coating.

Physical Properties and Testing

It was realized that while the hydrostatic head and moisture vapor transmission properties of the coated fabric were important considerations, the coating itself would have to exhibit certain other basic properties if it were to be of practical use. Among these were flexibility, flex resistance, aging resistance, abrasion resistance, and washing and/or dry cleaning resistance. Consequently, work was begun to build a practical coating compound using the solid pigment-synthetic rubber combination.

In the "Theory" section, it was determined that the resultant coating would have to be composed of a large volume of pigment bound together with a binder. Because the pigment volume plus the void volume in the dried coating was so large in relation to the binder volume, it was necessary to select a binder which had high strength. In addition, it was deemed important to have a coating which was flexible and resistant to solvents. Although a large number of binders were investigated, the requirements were such that an oil-resistant synthetic rubber was finally selected.

The choice of the pigment, as directed by the theory, became rather clear cut. Of those pigments discussed in the "Theory" section, the one labeled (1) not only exhibited exceptional hydrostatic head and moisture vapor transmission properties, but also was low in cost, readily available, and lent itself to the process. This pigment was, therefore, chosen. Once the selection of the pigment and the rubber had been made, a great deal of time was spent in working out a compound which would have those physical properties desired.

To better understand the development of the final compound and its excellent physical properties, a backward glance must be taken to that stage of the development where an untreated porous pigment was being

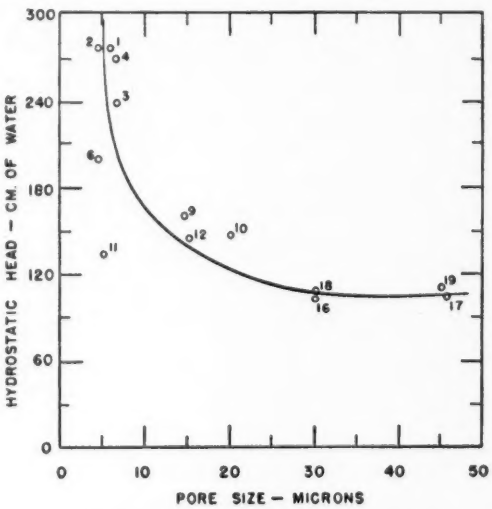

FIG. 3—Pore Size vs Hydrostatic Head.

used with a synthetic rubber binder. This combination, when used to produce a coated fabric, was then considered to exhibit such physical properties so as to warrant durability field testing. Its properties, as measured in the laboratory, are given in Table II.

Field tests were arranged at the Quartermaster Board, Camp Lee, Virginia *(4)*. The technique employed involved four phases, namely: Rain, Obstacle, Glove, and Combat courses. Impermeable and uncoated garments were run for comparison purposes, along with the water impermeable-water vapor permeable garments. It was desired to determine water vapor permeability, durability of coating, and water impermeability of the latter garments. The objective of the tests was to determine if the experimental fabric had sufficient merit to warrant further development, and also the field test results were to serve as a guide in any resultant future work.

These tests were conducted and the results showed some deficiencies in the fabric. Examination of the tested experimental garments indicated that wherever leaking had occurred, it was due to low abrasion and flex resistance of the coating.

The comments of the test subjects, pertaining to each phase of the test, and the statistical analysis obtained, resulted in the recommendation and conclusion that work be continued on the experimental fabric with especial emphasis being placed on the toughening of the coating and improving the flexibility. In addition, it was suggested that in the future the portions of the test on moisture vapor transmission and degree of comfort be conducted under closely controlled conditions, as the perspiration rate varied so much between individuals that a true evaluation was not possible in a general field test.

The faults in the experimental fabric, as determined by field testing, had to be corrected. To accomplish this a number of more strenuous laboratory tests were needed along with basic changes in the compound.

The field tests showed that the hydrostatic head of the coated fabric, as obtained with the ASTM tester on the aged and unaged fabric, was insufficient to meet the needs. In order to obtain a more strenuous hydrostatic head test, the Suter machine was adopted as standard. An extension was added to this tester so that a maximum of 277 centimeters of water pressure could be applied. In this test, water pressure is applied over 5 times the sample area of the ASTM tester and failure is considered at the appearance of the first rather than the fifth drop.

To fully test the coated fabric for waterproofness, the modified Suter test was run on the fabric in its original condition, after 96 hours Weather-Ometer aging, after 1200 flexes on the Chrysler flex machine, and after 96 hours Weather-Ometer aging followed by 1200 flexes on the Chrysler flex machine. When the fabric which had been field tested was evaluated on these tests, the reason for leakage during the field tests was apparent. The Suter hydrostatic head resistance of the fabric after Weather-Ometer aging, followed by flexing, was extremely low.

TABLE II—PHYSICAL PROPERTIES OF FIELD TESTED FABRIC
(Untreated Porous Pigment-Solvent Cement Binder)

Hydrostatic Head cm. H_2O ASTM (5th drop to penetrate)	249
Moisture Vapor Trans. % of Base Fabric (Open Cup method)	59
Hydrostatic Head cm. H_2O after 600 flexes (Chrysler Flex Machine)	180
Hydrostatic Head cm. H_2O after 96 hours Weather-ometer Aging	259
Taber Abrader Loss, grams after 1000 cycles using 500 gm. weight and CS-8 wheels	0.230
Weight of Coating, oz./yd.^{2}	3.1

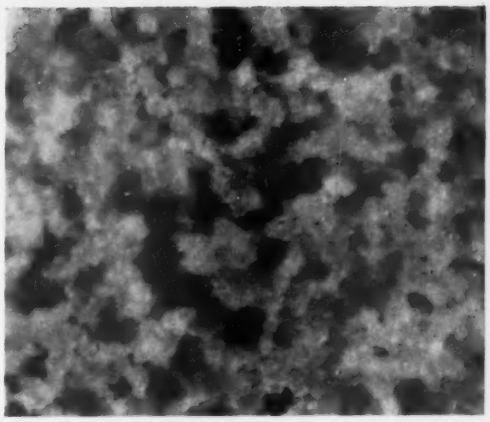

FIG. 4.—Horizontal cross section of water impermeable-water vapor permeable coating. (Magnification: 300X).

The physical properties of the coated fabric as field tested represented the optimum properties obtainable with the porous pigment-rubber binder combination of that stage of the development. However, simultaneous work being carried on with the solid pigment-rubber combination was at such a point as to show its superiority over the porous pigment in obtaining high hydrostatic head resistance of the coated fabric. This combination also appeared to present more latitude in obtaining higher hydrostatic head resistance since the pore size could be varied by the choice of pigment whereas the pore size using the porous pigment was fixed.

Using the solid pigment-synthetic rubber combination discussed earlier in this section, it was found that the hydrostatic head resistance of the coated fabric after aging and flexing was superior to that obtained with the porous pigment-synthetic rubber combination. Since these hydrostatic head values were still under 100 centimeters of water, concerted efforts were made to improve this property.

The thought occurred that possibly the hydrostatic head resistance of the coated fabric might be raised if the angle of contact of the coating material was raised. In order to raise the angle of contact of the coating, it was necessary to incorporate into the coating, materials having a higher angle of contact than the coating itself.

Waxes, which are known to have a high angle of contact, and to bleed to the surface of a rubber compound, seemed a logical choice. In addition, two other benefits could be seen as a result of the bleeding action of the wax. First, the pore diameter would be reduced by the film of wax and, second, the aging of the compound would be improved. This second benefit might have been of prime importance since examination of the theory and basic structure of the coating brought to light that possibly unusual aging was taking place due to the open nature of the coating.

TABLE III—TYPICAL PHYSICAL PROPERTIES OF A WATER IMPERMEABLE-WATER VAPOR PERMEABLE FABRIC
(Solid Pigment-Solvent Cement Binder)

Weight of Coating, oz./sq. yd.		4.0
Hydrostatic Head, cm. of water		
Original		277+
After flexing, 1200 flexes Chrysler flex		277+
After O_3 Bomb Aging, 96 hours		277+
After Weatherometer Aging, 96 hours		277+
After Weatherometer Aging, 96 hours + 1200 flexes		277+
After Resist. to Low Temp. (creased at −20° F.)		277+
After Washing (5 cycles)		112
After Dry-Cleaning (5 cycles)		109
Moisture Vapor Trans.—% of Base Fabric		
Original		73
After Washing (5 cycles)		75
After Dry-Cleaning (5 cycles)		75
Adhesion Pounds/2" width		
Original		6.7
Flexibility (Clark Softness) cm.,	@ 70° F. Warp	9.8
	Filling	7.2
	@ 0° F. Warp	11.1
	Filling	8.6
After Heat Treat. 5 hours	@ 220° F. Warp	10.1
	Filling	7.7
Abrasion Resistance		
Taber abrasion, grams loss, CS 8 wheels, 500 gm. wt., 1000 rev.		0.100
Wyzenbeek (rubs to expose fabric) 6 lbs. tension, 3 lbs. pressure, 3/0 emery cloth		30
Blocking, 220° F., 30 min.		No blocking

Note: Fabric was 5.2 oz. water repellent Byrd cloth coated on one side.

Addition of the wax to the basic compound confirmed the above thinking in that the coated fabric, after being aged and flexed, exhibited a hydrostatic head resistance of well over 200 centimeters of water.

At the same time these improvements were being made in the compounding of the coating, investigations were undertaken to develop better coating techniques on various fabrics. Earlier work had shown that this type of coating could best be applied to tightly woven, fine thread, water repellent treated fabrics. A weight-of-coating study was made on such a fabric, and it was found that when 4.0 to 5.0 oz./sq. yd. of coating were applied, maximum physical properties were obtained. Coating weights as low as 2 oz./sq. yd. showed reasonably good properties, while coating weights of 8 oz./sq. yd., or above, tended to crack when bent sharply with the coating out.

It was found that the coating was best applied to the fabric in a three-coat operation: one tight coat, to anchor the coating to the fabric, and two spread coats in opposite directions to completely cover the fabric. Attempts to reduce the number of passes resulted in spotty hydrostatic head results because of incomplete coating around slubs and let-outs in the fabric.

Investigations have indicated that the coating can be successfully applied to one or both sides of the fabric and still retain high moisture vapor transmission rates. In addition to the tightly woven fabrics previously discussed, work has shown that excellent results can be obtained on such a fabric as sheeting. Here, to simulate fabric used in Army raincoats, a heavy coat was applied to one side of the fabric and a light coat to the other side. Actually, to meet the properties of the higher grade, 4.0 to 5.0 oz. one side coated fabrics, a heavier weight of coating was required (5.0 to 6.0 oz./sq. yd.).

During the entire development, it was recognized that the coated fabric would have to be cleaned by washing and/or dry cleaning. The coated fabric finally developed does withstand 5 cycles of either of these cleaning methods, retaining a Suter hydrostatic head of over 100 cm. of water.

As a result of the compounding studies and the improvement in coating techniques, it has been possible to produce on conventional rubber spreader equipment considerable yardage of a water impermeable-water vapor permeable coated fabric. A typical example of the data obtainable on this type of coated fabric is shown in Table III.

Examination of these data, along with those given in Table II, will show that not only have improvements been made in the waterproofness, both before and after aging, but also the moisture vapor transfer rate has been increased considerably. Another property of prime importance is the abrasion resistance. This has been increased more than twofold. It was coated fabric of this type which was field-tested for comfort at the Quartermaster Climatic Research Laboratory, Lawrence, Mass.

Arrangements were made to conduct comfort tests on the coated fabric at the Army Quartermaster Corps Climatic Research Laboratory, Lawrence, Mass. J. W. Eliot, R. Bader, W. Goddard, and H. Hanson, carried on this work *(5)*. The prime purpose of this work was to evaluate the moisture transmitting properties of the coated fabric.

Three types of fabric, of the same approximate weight, were used in this evaluation. Parka and trousers assemblies were fabricated using the water impermeable-water vapor permeable coated fabric and, for control, assemblies were made from an impermeable coated fabric and an uncoated fabric. Additional clothing worn by the subjects was selected on the basis as being the most likely to be worn in the field, with the same climatic conditions prevailing.

The tests were to simulate two separate field operations that might be encountered by individuals wearing parka and trousers. These were (1) as a continuous wear exposure suit, i.e., a garment capable of remaining immersion-proof should an aviator parachute into the sea, yet capable of transmitting perspiration from the aviator's clothing to maintain comfort during long periods of wear and, (2) a suit for use in wet-cold field conditions, where there is exposure to wetting from without and a high relative humidity making evaporation difficult from within.

To simulate those conditions prescribed, the climatic chambers during test were maintained at two conditions: (1) Temperate—Temperature at 75°F. and relative humidity at 50%, with wind velocity at 3.0 miles per hour; (2) Wet-Cold—Temperature at 30°F. and relative humidity at 60%, with wind velocity at 3.0 miles per hour.

Eight test subjects were selected and conditioned by walking on a treadmill (Figure 5) in the climatic chambers two hours a day, five days a week for two weeks.

After conditioning of the test subjects, the tests were conducted with a rotation of garments among the subjects so that various sweat rates could be averaged out. In the temperate experiments, the men were exposed for five hours, exercising by walking on level treadmills at 3.5 miles per hour for ten minutes and sitting quietly for the other twenty minutes of each half hour. In the wet-cold test plan, the test subjects were exposed for two hours, walking continuously on treadmills at 3.5 miles per hour.

Physiological measurements were made to determine the body weight change, moisture uptake of the garments, skin temperature, and rectal temperature. In addition, the test subjects' observations and calculations

were recorded. The body weight change which was obtained by weighing the men nude before and after each exposure was used as an index of total sweat output. The moisture uptake was determined by obtaining the weight of each item of clothing before and after exposure. Skin temperatures were taken every ten minutes during the exposure by means of copper-constantan thermocouples attached to the skin. These thermocouples were read by a self-balancing recording potentiometer. The thermocouples were positioned as follows:

a. Underside of terminal phalanx of great toe.
b. Medial side of thigh, midway to knee.
c. Abdomen, two inches lateral to umbilicus.
d. Back, midline, at 7th cervical vertebra.
e. Back of calf.
f. Medial side of terminal phalanx of index finger.

The rectal temperatures were also taken at ten minute intervals and recorded in the same manner.

In their report on the tests, the authors state, "It is evident from body weight losses, moisture absorption of the uniforms and skin and rectal temperatures under these experimental conditions that the experimental semi-permeable material is far closer in its moisture transmitting behavior to the control permeable material than to the control impermeable material . . .

"Under both the wet-cold and temperate conditions the average total sweat loss was less with the semi-permeable fabric than with the impermeable fabric. Inasmuch as sweat production by the body is quantitatively indicative of the heat load being imposed by clothing, it is fair to state that this difference represented a decrease of better than 60 calories in the heat load imposed on each man during the periods of exposure.

"It is calculated that the total heat production of each man, both in the two-hour wet-cold exposures and in the five-hour temperate exposures, approximated 600 to 700 calories. This means that the heat load saved by use of the experimental fabrics under these conditions represented (very roughly) ten per cent of the total load imposed."

In addition the authors concluded, ". . . from a physiological point of view, standardization of Rain Suits or even continuous-wear exposure suits manufactured from fabrics containing the degree of vapor permeability found in the experimental fabric tested here, is desirable."

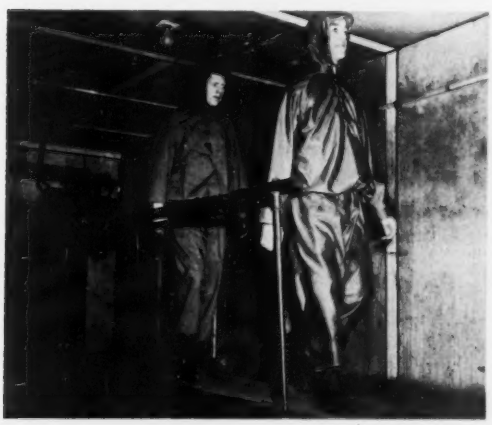

FIG. 5—Comfort Test: Man on the left wearing standard impermeable parka and trousers, man on the right wearing experimental vapor-permeable suit on treadmill at 3.5 m.p.h. under controlled environmental conditions.

TABLE IV—BODY PERSPIRATION TRANSMISSION AS DETERMINED BY CLIMATIC TESTING

Type Fabric In Garment	Impermeable Coated	Water Impermeable-Water Vapor Permeable Coated	Uncoated Fabric
% Perspiration transmitted through garment; transmitted average at 75° F.; 50% R. H.	56.2	84.5	85.4
% Perspiration transmitted through garment; transmitted average at 35° F.; 60% R. H.	43.4	64.9	65.6

Data in Table IV show exactly why the water impermeable-water vapor permeable coated fabric can be considered to be very close in its ability to transmit moisture vapor to that of the uncoated fabric.

Conclusions

A coated fabric has been developed which is waterproof and simulates uncoated fabric in wearing comfort. This coated fabric has good flexibility, flex resistance, aging resistance, abrasion resistance, and washing and/or dry cleaning resistance. Field testing and controlled climatic testing have indicated the usefulness of this coated fabric.

Further developmental work is in progress in the application of this coated fabric to such end items as tentage, sleeping bag covers, raincoats, footwear, and other items in which the properties of waterproofness and the ability to transmit water vapor are desirable.

ACKNOWLEDGMENT

The authors wish to acknowledge the assistance of Drs. L. H. Willisford, G. F. Roquemore, and W. K. Gosnell of the Goodyear Tire & Rubber Company, Drs. W. Stubblebine and C. J. O'Boyle of the Office of The Quartermaster General, and those members of the Chemical Products Development Division of the Goodyear Tire & Rubber Company and members of the Quartermaster Research Laboratories who, in various capacities, have contributed to the successful completion of this development.

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Kalabond RM-2
A New Type Rubber-to-Metal Adhesive

By E. V. OSBERG and G. S. SCHAFFEL

General Tire & Rubber Co., Akron, Ohio

KALABOND RM-2, an entirely new type of rubber-to-metal adhesive, is unique in that it provides a direct chemical bridge between the rubber and the metal. The new adhesive is based on a tailor-made polymer, containing reactive chemical groups. It seems apparent that these groups react with the metal surface to form a strong chemical bond. The polymer itself appears to be compatible with most types of rubber and to covulcanize with these elastomeric compounds. Thus, during vulcanization, the adhesive polymer reacts with both metal surface and rubber to permanently join both materials.

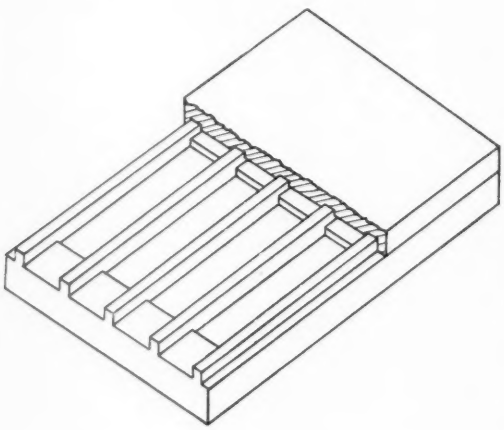
Research Objectives

During the research program which resulted in the development of Kalabond RM-2, the following factors were considered as important requisites for a good rubber-to-metal adhesive:

1. *Versatility*—The adhesive should be capable of bonding a wide range of practical rubber stocks to a variety of metals.

2. *Ease of Handling and Application*—No special precautions and production methods should be required for the handling and the application of the adhesive.

FIG. 2—Placing shear specimen in the testing machine.



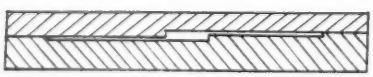


FIG. 1—Sketch showing construction of four-cavity mold for preparation of shear specimens.

3. *Dependability*—The adhesive should be relatively insensitive to minor operating variables. Once adopted in production, it should provide uniform, dependable adhesion to minimize rejects due to bond failure.

4. *Performance*—The bond obtained should be able to withstand conditions encountered in service as, for example, aging, corrosion and attack by water solvents, and oils.

In consideration of the complexity of rubber to metal adhesion, Kalabond RM-2 goes a long way towards meeting these objectives. This new adhesive will bond natural rubber, GR-S, nitrile rubbers, and neoprene to steel, stainless steel, aluminum, zinc, Dowmetal, brass, monel, and nickel.

Kalabond RM-2 is uniform and stable, and from tests conducted so far, it can be stored for extended periods without loss in bonding strength. Because the material is relatively homogeneous and simple in composition, no special handling and mixing precautions are necessary. It contains no halogen and has definite anti-corrosive properties. Bonds are highly resistant to aging, solvents and oils, and boiling water.

Test Method

The method used in evaluating Kalabond RM-2 differs from standard methods. In setting up this test, the intent was to find a simple reproducible method that would give dependable performance characteristics and that would approximate common factory produc-

TABLE I—SUMMARY OF ADHESION DATA ON KALABOND RM-2

	Natural Rubber		GR-S		Hycar	Neoprene
Smoked Sheet	100					
GR-S			100	100		
Hycar OR-25					100	
Neoprene						100
EPC black	50		50	50	30	50
SRF black					45	
Zinc oxide	5		5	5	5	5
Light calcined magnesia						4
Sulfur	2.75		2.0	1.0	1.5	
Benzothiazyl disulfide	1.5		1.5		1.5	0.8
Ethyl Zimate				1.0		
Agerite Powder	1.5					2.0
Stearic acid	1.5					0.5
Agerite Resin D					2.0	
Dibutyl phthalate					10	
Process oil						5.0
Cure @ 308° F. (min.)	15		30	20	20	20
Tie Cement	None	TC-149	None	None	None	None
	Adhesion—Pounds Pull in Shear					
Steel—unaged	1121	1238	1685(B)	1055	933	1611
Steel—aged (E)	865	(D)	1645(B)	(D)	760	1557
Steel—hot water (F)	1161	(D)	1356(B)	(D)	1030	1383
Stainless steel	1120	1522	1643(B)	542	1082	1452
Aluminum	952	1156	1223	(C)	867	985
Zinc	427(A)	477(A)	463(A)	207	477(A)	485(A)
Dowmetal	961	1205	1128	660	900	1265
Brass	1257	1248	1842(B)	1627	1045	1716
Copper	355	295	420	(C)	261	120
Monel	1071	1270	1125	363	693	877
Nickel	690	895	863	345	771	827
Bronze	320	610	163	(C)	847	1361

(A) Metal failure. (B) Stock failure. (C) No significant adhesion. (D) Not tested. (E) Aged in oven 48 hours at 100° C. (F) Immersed one week in boiling water and tested after drying four hours at room temperature.

tion testing. With this in view, a shear-type test was developed.

In this adhesion test, a one-inch square section of the rubber compound, 0.040-inch thick, is molded between two strips of metal (3¾ inches long, 1-inch wide and 0.035-inch thick), with contact areas previously coated with adhesive. This forms a lap specimen 6½ inches long, which is pulled in shear to failure on a universal tester. Results are expressed in total pounds pull. Figure 1 shows the construction of the mold used for preparing the lap specimen, while Figure 2 is a close-up of the sample ready for test in the universal tester. Figure 3 shows the universal tester in operation.

Table I presents representative compounds based on natural rubber, GR-S, nitrile rubber, and neoprene. The adhesion data show the bonding strength of Kalabond RM-2 when used with these compounds and various types of metals. In the case of steel, results are shown on aging and immersion in boiling water.

The versatility of Kalabond RM-2 is demonstrated in these results on the adhesion of four different type rubbers to a wide variety of metals. Variations in compounding, particularly in respect to acceleration, have a definite influence on adhesion values. In general, ultra accelerators tend to lower bond strengths. In some cases, the use of a tie cement may be desirable to raise the level of adhesion; the improvement obtained on the natural rubber stock by the use of Kalabond TC-149 is shown in the table.

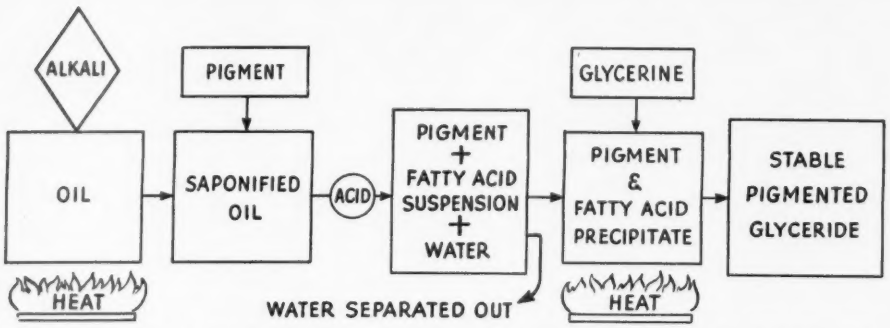
Kalabond RM-2 appears to be generally satisfactory for most metals except copper and bronze. However, good results are obtained when bonding neoprene to bronze.

Summary

Kalabond RM-2 is a new type rubber-to-metal adhesive that provides a positive chemical bond during vulcanization between rubber and metal. Ability to bond different types of rubber to various metals provides versatility in application. Kalabond RM-2 bonds are resistant to corrosion, aging, water, and solvents.

FIG. 3—Universal tester used in rubber-to-metal adhesive evaluation.

Pigment Dispersion Process Eliminates Grinding and Milling



GENERALIZED SCHEMATIC REPRESENTATION OF KOL PROCESS

A SIMPLE new chemical transfer process for the combination of metal pigments—free of water—with resins and oils has been perfected by the Commonwealth Engineering Company, applied research and development organization of Dayton, Ohio. The new method substitutes kettle, heat control and stirring apparatus for the heavy mills presently used to break down and disperse pigment into pastes.

Called the Kol process for the colloidal aspects involved, the method effects a complete and homogeneous dispersion which may be used for paints, plastics, inks, linoleums or whenever a pigment paste is required.

In the first phase of the process, the vehicle raw material is saponified by the addition of an alkaline agent. To it, under the influence of gentle heating, is added the pigment either as press cake or in a slurry. The addition of a small amount of a weak acid such as acetic anhydride accomplishes the precipitation of the pigment and fatty acid oil components. The separated water is discarded.

Glycerine is then introduced and the mixture subjected to a heat treatment to esterify the fatty acids and produce the mono-, di- and tri-glycerides of these acids. The resultant product is an oily pigment paste dispersion of smooth consistency, comparable to the present grinding-mill product.

In addition to pigmented oil gels, pigmented fatty acid glycerides, resins, and resin gels may be prepared by variant procedures under the foregoing method. A total of eight U. S. patents have so far been issued as a result of work under the Kol development with other applications pending.

The new method involves only the use of stainless steel containers, plus control heat for effecting the chemical reactions. Such equipment is the same as that normally used in the remainder of the processing which paints and plastics undergo, and hence can be integrated with the latter in a continuous process arrangement, eliminating the batch method now used.

Besides introducing continuity of production, the new process is subject to a simple and sensitive control. Reduction in the investment in machinery is significant, as is reduction in labor due to the extreme simplicity of operation.

All-steel lines with unlimited flexibility can be fabricated to handle steam and other fluids by installing new type **high temperature swivel joints** now being made by the Chiksan Co., Brea, Calif. Built to operate at temperatures to 600° F. and maximum working pressure of 300 psi, the joints are made in 8 different styles for full 360° turning in 1, 2 and 3 planes.

Designed to resist especially severe conditions, a new **floor surfacing material** is being marketed by United Laboratories, Inc., Cleveland, Ohio. Called Quartex, the new material is said to be ideal for surfacing floors subjected to alkalis, oil, grease, fats, etc. Applied directly over the old surface at a depth of approximately one-half inch, Quartex is ordinarily ready for use within thirty-six hours.

Covering a range of 0 to 100 pounds and featuring an accuracy of ½ of 1%, a new **hand-operated multi-low-range universal testing machine** was recently introduced by W. C. Dillon & Co., Inc., Chicago 44, Ill. It is said to be the first entirely hand-operated physical tester ever to be made available in such a low testing range. It handles specimens in tensile, compression, transverse and shear.

A new type of patented **swivel joint** suitable for use with platen presses, vulcanizers, mixing machines, etc., was recently developed by the Seamlex Co., Inc., Long Island City, N. Y. Called "Swivlex," the joint features an exceptionally easy swivel due to an internal equalizing chamber which balances the pressures on both sides of the swivel seat and the use of ball bearings to reduce friction in the housing to a minimum. It is suitable for 400 psi maximum pressure and 600° F. maximum temperature.

Bristol Co., Waterbury, Conn., has announced the development of a new combustion safeguard known as the **Bristol Electronic Pyrotrol.** The new instrument protects gas-fired furnaces, ovens, kilns, boilers, dryers, kettles, etc., from danger of gas explosions during ignition, operation and shut-off.

Properties and Applications of Depolymerized Rubber

By KENNETH V. HARDMAN and ARTHUR J. LANG

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DEPOLYMERIZED rubber, now commercially available as DPR*, is certainly an interesting transmutation of rubber. Imagine a crude rubber softened to the extent that it will actually flow at room temperature! This should prove stimulating to some of our technologists who have complained that in a field so well explored as natural rubber it seems increasingly difficult to provide some new or exciting contribution to the art. The existence of a crude rubber disaggregated or depolymerized to the flowable state and capable of being reconstituted may well open the field for many new developments.

This contribution deals with a form of natural rubber not new as such theoretically but as a newly available commercial raw material. Depolymerized rubber is 100 per cent all rubber solids. It is a flowable modification of a standard natural rubber, such as ribbed smoked sheets. It has been mentioned frequently in the technical literature *(1-10)*, by Staudinger and Van Rossem among others, and is the subject of several patents *(11-24)*. Some attempts have been made in the past to partly depolymerize rubber before shipment to consuming factories, usually by a heat softening process, to save breakdown time. Notable among such processes is one developed by Schidrowitz *(25)*. The addition of peptizing agents to Hevea latex at the plantation for partial softening has also been attempted.

Properties of Depolymerized Rubber

In the case of rubber depolymerized to the semi-liquid or liquid state, DPR may be used as replacement in chosen percentage for conventionally refined rubber for rapidly achieving the desired softening effect. This offers obvious advantages.

Crude rubber in this unique physical form has been produced in experimental quantities by many investigators who recognized the potential merits of a low viscosity solventless rubber. It has been known variously as liquid rubber, plastic rubber, melted rubber, etc., and has actually been used in some small volume for special purposes, in spite of the crude and relatively primitive methods employed in its production. Many of these workers confess they became so discouraged trying to produce uniform base quantities of depolymerized rubber, that they could hardly do justice to their original ideas.

DPR is now available in commercial quantities, and renewed investigations are taking place in many phases of the rubber field. Actually, depolymerized rubber has been produced, by a thermochemical process, and under continuous development by the Hardman Company for over twenty years.

Like any other straight uncured crude rubber, DPR becomes softer with warmth and more rigid with cold temperatures. However, DPR is available in a range of controlled consistencies which at room temperature vary from a standard free-flowing consistency to a viscous flowable semi-solid. The color of DPR in bulk form is a rather dark brown, and amber when spread in thin films on white paper. The material is about as stable chemically as conventional crude rubber, remaining very stable for years when not in direct sunlight. If thin films of straight DPR are exposed to air and direct sunlight, the surface will quickly oxidize and wrinkle. Under normal storage conditions, however, depolymerized rubber is considered very stable.

Compounding Methods

DPR has many uses in the unvulcanized state. It is itself vulcanizable, however, and may be compounded with sulfur and other appropriate ingredients, the resulting compounds finding application as such. Normal DPR compounds are free-flowing for the most part, and while they are naturally inferior in elasticity, tensile and elongation to conventionally milled and cured rubber stocks, they have found certain uses for which they are entirely adequate and which, incidentally, can hardly be duplicated by rubber fabricated by conventional means. With specialized techniques, new products have been made possible which simply could not be made with conventional rubber stocks; moreover, no heavy or costly equipment is required.

Depolymerized rubber compounds can be spread, troweled or cast into molds and vulcanized in hot air at atmospheric pressures. For instance, in the cable industry, wire may be drawn through a tank of DPR compound to form a coating, with the coating cured immediately without the problem of solvents or shrinkage. Thermo-injection of rubber is aided by inclusion of DPR in the compound.

Rubber in depolymerized form is in many cases more compatible than natural crude rubber with certain straight and modified phenolic resins, such as the Cardolites and Durez resins. The blending of the properties of the two materials is often advantageous. Straight hard rubber for brake linings may have too low a softening point, for instance, whereas certain types of phenolic resins may be too hard and friable, with a tendency to glaze. In this case, one material complements the other, producing a lining with intermediate qualities and superior to a lining made with either material alone. Many resins confer characteristic effects. Coumarone-indenes, furanes, Piccolytes, etc., may be simply fused in by stirring above the melting point of the resins.

Dry pigments are best dispersed at room temperature. To insure smooth dispersions, free from agglomerates, dry pigments and powders should be sifted prior to being added to the depolymerized rubber. Most ingredi-

* Registered trade mark.

ents in powdered form disperse very easily, such as sulfur, clay, whiting, Silene EF, blanc fixe or carbon black. These fillers and reinforcers, zinc oxide, etc. are used for the same purpose in DPR as they are in conventional rubber compounds and endow in general the same properties. Titanium dioxide, brown, red and other coloring pigments may also be dispersed if necessary. The DPR of proper consistency is usually put into an open mixer, such as a slow driven churn, Lancaster mixer or any appropriate mixer, as determined by the final desired consistency of the stock. For extremely high consistency pastes, it may be necessary to use a mixer of the internal double blade type. For the best dispersion of pigments in a light viscosity stock, a part of the DPR is weighed in and then all of the dry powders are sifted and dispersed, followed by the remainder of the DPR and finally any oils if called for. The warmth caused by the friction of mixing facilitates removal or pouring of the compounded finished batch. Special electrically-heated gear pumps have been designed to facilitate the handling and metering of DPR compounds *(26)*.

Use of Unvulcanized DPR

In the uncompounded state, one of the most advantageous uses of DPR is as a vulcanizable plasticizer in crude rubber mixes. A flowable crude rubber is an ideal softener for crude rubber compounded on a conventional mill or in the Banbury. Replacing part of the refined rubber content, DPR vulcanizes along with the stock, yielding unusually high physical properties, and acting as a truly vulcanizable non-extractable plasticizer. DPR also has a plasticizing action on synthetic rubbers of the nitrile and styrene types, but such rubbers are not made substantially tackier by the addition. Conventional rubber batches on an open mill or in a Banbury take up additions of DPR rapidly and make possible higher loadings. DPR is also compatible with both Butyl rubber and Vistanex.

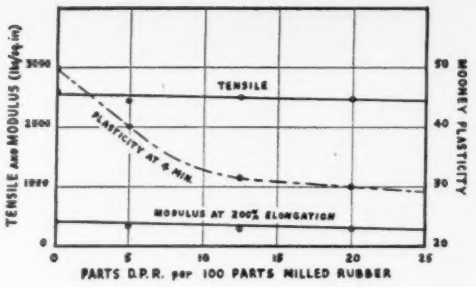
A report from an independent testing laboratory indicates that DPR has the definite merit of plasticizing natural rubber with no appreciable decrease of the physical properties of the vulcanizate. Four compounds were evaluated, one a control containing no DPR and the others with additions of 5, 12.5 and 20 parts, respectively. The base formula (by weight) follows:

Ribbed Smoked Sheets	100.0
Whiting	50.0
Zinc Oxide	5.0
Agerite White	1.0
Stearic Acid	0.5
Sulfur	3.0
Altax	1.0
Methazate	0.3
DPR (light viscosity)	Varied

The results are indicated on the accompanying graph. It will be noted that ease of processing becomes more evident as loadings of DPR increase. The negligible decrease in tensile and modulus is explained by the fact that in this investigation DPR was added to a base rubber compound with no extra sulfur added for the depolymerized rubber, thus giving the effect of decreasing sulfur content on the total rubber hydrocarbon. In actual practice, part of the milled crude rubber is simply replaced by DPR, the balance of the compound remaining unchanged.

Applications with Latices

Depolymerized rubber may also be used with various latices. For example, straight DPR, especially of thin viscosity, is dispersible directly into Revertex without causing coagulation. There is apparently sufficient protective colloid in the Revertex to completely isolate the DPR as it is being stirred into it. Microscopic examination of such blends discloses fine particle size exhibiting the usual Brownian movement.



Effect of additions of DPR to a natural rubber compound. (Cure: 5 min. @ 307 F.)

Blends of Revertex and DPR are usually very stable. Blends containing varying amounts of DPR from 10 to 100 percent have been put in jars and kept under observation for periods up to three years. It was noted that the blends in jars with air tight closures remained completely stable even after three years.

Admixtures of Revertex and DPR deposit high rubber solids, films being naturally tacky and exhibiting lower shrinkage than straight latex films. For carrying out experimental work with DPR in latex, it is suggested, therefore, that Revertex first be tried because of the ease of incorporation.

For aqueous dispersions, bentonite clay or a soap such as triethanolamine oleate may be used for the initial dispersion of DPR. This emulsion or dispersion may then be added to other types of latex or aqueous dispersions. If laboratory recommended procedures are followed, it will be found that DPR disperses without great difficulty in bentonite clay aqueous pastes. Such dispersions find application as binders for powders as well as latex plasticizers.

Adhesives and Allied Fields

A further field for DPR is found in special adhesives, either as a vulcanizable additive or in solvent cement systems. The incorporation of a DPR compound containing sulfur into asphalt coatings, for instance, prevents the sagging of the asphalt at elevated temperatures. In this case, a partial cure of the DPR is effected at the elevated temperatures, thus enabling it to act as a binder for the thermoplastic base. This faculty of DPR compounds to remain thermoplastic during application, and then become thermosetting at elevated temperatures to act as a heat resistant fixative, should find many similar uses. As the rubber compounder knows, combinations of accelerators may be incorporated so that elevated temperatures are not so necessary, the cure being effected with a few days' standing at temperatures of around 70° F.

For further consideration in the field of adhesives, it might be mentioned that the depolymerized form of rubber is just as active with certain chemicals (such as chlorides) as conventional crude rubber *(27)*. For instance, aluminum or iron chloride, stirred into and heated with DPR, will react and harden the mixture,

depending upon the percentage of chloride and the temperature of reaction. DPR, alone and unmodified, is sticky in the sense that fly paper is sticky, that is, it has little cohesive strength and low initial tack. When formulated with resins, such as rosin or Cumar, it will have higher initial tack, but will remain thermoplastic. When partly reacted with chemicals, such as chlorides of tin or iron, trichloracetic acid, maleic anhydride, sulfur, etc., DPR confers to its adhesives the ability to remain flexible at low temperatures and not to become excessively fluid at reasonably hot temperatures.

Some Specialty Applications

In greases and special lubricants, the addition of DPR imparts "cling," and, especially with graphite, permits them to withstand high pressures. Some of these specialty greases have been outstandingly effective. DPR has also been used in the field of specialty paints, printing inks and cordage dressings.

It is well to remember that DPR has definite limitations. For instance, many persons, when first informed of the availability of DPR, immediately think along the lines of a roof paint or roof dressing or a floor coating compound. These are natural thoughts, but upon analysis it is readily understandable that this form of rubber is not as satisfactory as certain other materials for these applications. As a roof paint, rubber does not withstand sunlight as well as many other materials, and as a floor covering, although it trowels nicely, it would have to be vulcanized to a rather firm and durable state, a process which is not easily carried out over large areas of floor space. In thin films, however, it has been used for special purposes. Incidentally, the addition of acetylene black to a troweled rubber surface, followed by partial curing with infrared lamps, will materially disperse static accumulation.

The addition of Shawinigan 100% compression acetylene black to DPR provides much higher electrical conductivity than similar additions to milled crude rubber batches. This is due to the fact that in the case of a low viscosity DPR mix there is better contact maintained between the particles of conducting black, whereas in milled rubber compounds each particle of black is more nearly insulated with rubber. Troweled and vulcanized radiant heating panels have been produced in the laboratory with such mixtures, and both hard and soft rubber compounds with controllable resistance and conductivity have given considerable encouragement through experimentation for cable fillers and for static eliminating areas. Considerable work has been done in the formulation of such compounds, especially for soft rubber stocks which are stable at room temperature for many months, but which will vulcanize to a soft rubber state in 10 or 20 minutes at about 250° F.

Another view of the Hardman laboratory showing some additional testing equipment.

Interior view of the Hardman laboratory with some of the testing equipment in view.

It is interesting to note that whereas acetylene black produces conductive compounds, it is also possible to obtain DPR formulations which are endowed with excellent electrical breakdown resistances and the usual insulation properties. For example, one hard rubber compound using mica dust had a power factor of 2 to 3% at 60 cycles, and a dielectric strength of from 388 to 412 VPM in sections of 250 mils.

The rapid softening effect caused by additions of depolymerized rubber into milled rubber provides the obvious advantage of saving milling time in the production of sponge stocks. Hard rubber of the cellular type has been produced as well as soft sponge stock. The usual blowing agents may be incorporated in the straight DPR compounds or in blends of DPR and milled rubber.

An interesting application of DPR sponge stock is for the under-matting used in the automotive industry. This type of carpet backing is simply spread and vulcanized immediately, without the problem of evaporation of solvents. Spreader stocks for certain types of combining and base coating may be prepared using DPR as a base. In this case, the usual equipment is varied to accommodate the higher viscosity stock, and curing may be accomplished by either hot air, infrared lamps or high frequency induction current.

The inherently desirable characteristics of DPR include its ability to be applied or shaped either by spreading or casting, followed by curing without the complication of solvent removal. This makes possible firm forms with practically no shrinkage. Furthermore, the uncured compounds are generally stable at room temperature for reasonable lengths of time. In this respect, this compound is quite unusual and different from organosols, plastisols and other castable resins. Many castable resins are two part cements or resins requiring the addition of a catalyst before casting or spreading in order to cure rapidly. It is this unusual combination of attributes in DPR compounds which makes possible the various uses described. Other uses incorporating these abilities include caulking and sealing compounds, joint sealers and putties.

Hard Rubber Compounds

While these new techniques and uses for depolymerized rubber as straight compounds are adequate for soft rubber within its limitations, it is noteworthy that DPR

hard rubber compounds are much more comparable in strength and physical properties to conventionally produced press cured hard rubber stocks. It is in the field of hard rubber that DPR has found most of its early applications. It is possible to produce not only cellular hard rubber but dense and pore-free sections.

The use of calcium oxide to provide dense, solid depolymerized rubber, either soft or hard, is the subject of a recently issued patent *(28)*. This valuable specific allows the simple casting or coating of masses of compound, cured without pressure and free of pores. Heretofore, thick sections cured with bubbles, and the compounds had to be vacuum treated to cause solid vulcanizates. This drawback naturally limited usage, but the use of calcium oxide now simplifies solid castings.

Compounds of the type described above are specially prepared at the Hardman plant and may be applied over dried wood, for instance, and vulcanized to yield hard rubber-covered wood, with excellent adhesion between the rubber and wood. Hard rubber-lined pipes, tanks, and the usual corrosive-resistant chemical equipment have been produced with straight DPR compounds with excellent results.

A high grade rubber formulation based on DPR, without the incorporation of conventional milled rubber, is normally a viscous but flowable paste, and may be warmed in order to flow level on a surface and be cured in a hot air oven. At first, the warmth causes the material to act as a thermoplastic, and become fluid enough to fill interstices and crevices; with continued or elevated temperatures, the reaction proceeds, carrying the compound toward the ebonite state. Well cured hard rubber stocks of this nature have extremely low water absorption, one sample gaining 1% in weight after six months in water. For some applications, adhesion is definitely undesirable and in such instances Silicone DC-4 has been found to be an effective mold release lubricant. Addition of stiffening fillers such as Silene EF or carbon black make non-flowing, trowelable pastes which do not sag when cured on vertical surfaces.

Typical Compounds

Typical compounds of the type discussed above for casting, soft rubber cable fillers, combining, caulking, etc., follow:

BASIC CASTING COMPOUND

DPR (Thin Viscosity)	100
Bardol	0–20
Sulfur	5–50
Clay or Silica	50–90
Calcium Oxide	10
Diphenylguanidine	1

COMPOUND FOR SOFT RUBBER CABLE FILLERS, COMBINING, CAULKING, ETC.

DPR (Thin Viscosity)	100
Oleic Acid	1
Zinc Oxide	10-100
Sulfur	5
Filler (Clay, etc.)	50-100
Mineral Oil (Light)	15
Mercaptobenzothiazole	2
Tetraethylthiuram Disulfide	1

Summary

This contribution covers both actual uses and suggestions for depolymerized rubber and it is hoped that they will serve as examples to incite new ideas and techniques. The ability of DPR to provide new products or to be used for conventional products with an over-all cost saving seems to warrant its selection for many applications. While the price per pound of the compound may prove somewhat higher than conventional rubber compounds, specific advantages gained have ensured DPR a place as a new and tangible raw material. Many of the products mentioned herein are already in actual production while others are in the development stage.

Any material which enables the production of new articles, or permits established products to be made by improved methods, warrants the recognition of the manufacturing industry. It should be obvious that this article is general and of an introductory nature. It is believed that more specific data will be published in the near future.

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Plasticity of Reclaimed Rubber

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RECLAIMED rubber may be defined as the product resulting from replasticizing of scrap vulcanized rubber. This definition calls attention to an essential characteristic of reclaimed rubber—its plasticity—and, indirectly, to methods of measuring plasticity of the product.

The reclaiming industry and its customers use standard methods for chemical analysis and for physical testing for tensile strength, elongation, hardness and specific gravity. In spite of the importance of the plastic property of reclaimed rubber, no single method of measuring it has yet been generally adopted.

It is the purpose of this paper to bring to the attention of the industry the lack of agreement on methods of measuring plasticity as applied to reclaimed rubber, to indicate some of the factors affecting such measurements, and to emphasize the need for further investigation of the subject. We do not intend to enter into theoretical considerations concerning the nature of plasticity or a mathematical discussion of the results obtained by different methods. The methods used are well known and the results have been expressed in the units customarily associated with each method.

Reclaimed rubber, like natural rubber itself, is not a truly plastic material. The compounder's need is simply for a numerical index, preferably of application to all types of reclaimed rubber, which parallels the ease or difficulty he experiences in handling the product on conventional rubber machinery. He needs to measure reclaimed rubber's important properties such as: (a) Reduced power consumption: (b) Dimensional stability in uncured state; (c) Uniformity from lot to lot, (d) Faster breakdown and mixing.

In this paper we have measured plasticity by four conventional laboratory methods and by one full scale factory processing test. These methods are as follows:

The Williams Method *(2)*.
The Mooney Viscosity Method *(3, 4)*.
The Firestone (Dillon) Extrusion Method *(5)*.
The Laboratory Milling Test Method *(1, 6)*.
Full Scale Factory Processing Test (a three to five minute mastication in a 3-A Banbury with the power consumption measured).

Five typical reclaimed rubbers produced by our company were selected for the work. These reclaims are described below:

5303—Made from peelings with limited period of heating in open steam. Contains added pine tar oil. Rubber Content 48.7. Specific Gravity 1.19.

5304—Made from airbags, thoroughly heated in open steam. No added oils. Rubber Content 30.7. Specific Gravity 1.56.

5313—Made from passenger tires without treads. Thoroughly softened with oils and heat in alkali digester process. Rubber Content 49.6. Specific Gravity 1.19.

5314—Blend of digester and open steam, tire and peelings scraps. Contains neutral, alkali and zinc chloride digested scraps. Rubber Content 43. Specific Gravity 1.20.

5316—Open steam (pan) process tube reclaim. Contains pine tar and added alkali. Rubber Content 50.35. Specific Gravity 1.18.

TABLE I—PROPERTIES OF RECLAIMS TESTED

Type of Scrap	Peelings	Airbags	Carcass	Modified Whole Tire	Black Tube
Reclaim Number	5303	5304	5313	5314	5316
Chemical Analysis:					
Acetone Extract	12.70	8.55	12.80	20.57	11.05
Cured $CHCl_3$ Extract	1.08	1.11	.82	.77	.74
Ash	11.37	48.13	17.73	13.80	19.55
Total Sulfur	1.50	1.50	1.50	1.50	1.50
Carbon Black	22.21	7.50	14.77	19.97	15.85
Cellulose	2.43	2.51	2.75	.42	.96
Rubber Content	48.71	30.71	49.63	42.97	50.35
Alkalinity	.02	.08	.26	.105	.46
Physical Test:					
Specific Gravity	1.193	1.56	1.19	1.20	1.184
Cure	25'@287	25'@287	25'@287	25'@287	25'@287
Stress @ 300%	—	—	420	505	515
Elongation	270	265	530	430	530
Tensile	1060	630	1045	845	1370
Shore Hardness	55	62	44	49	49
Test Formulas:					
Reclaim	200	286	200	222	200
Zinc Oxide	5	5	5	5	5
Stearic Acid	2	2	2	2	2
Sulfur	3	3	3	3	3
Captax	0.5	0.5	0.5	0.5	0.5
DPG	0.2	0.2	0.2	0.2	0.2

The reclaims described above were produced early in 1949 and 1,000 pounds of each were stored at room temperature for two months. Plasticity tests were run at end of one day, one week, two weeks, one month and two months storage. Plasticity measurements (power consumption tests) in the 3-A Banbury were made after one week, one month and two month periods. The data show that certain reclaims appear to become less plastic on aging while others do not change greatly. The data also show that some methods of measurement are more sensitive to change in plasticity with age than others.

Table I gives the complete analysis and customary physical tests obtained on the reclaims examined.

The methods used for measuring plasticity are specified in the following paragraphs.

Determination of Plasticities

Milling Test: Five slabs of each reclaim were taken for the milling test determination. The specific gravity was determined and a batch size of 1000 grams for reclaims under 1.40 g. per c.c. was used. For higher specific gravities a 1500 gram batch was used. Each milling test sample was made up by using approximately equal portions of each of the five slabs.

The laboratory mill had the following characteristics:

Mill Rolls—16 in. long x 8 in. diameter.

Roll Speeds: Fast Roll—21-22 RPM, Slow Roll—14-15 RPM.

Roll Temperature—95°F ± 3.

Mill Setting (determined with a piece of lead 0.5 in. sq. x 0.1 in. thick) — 0.072 in. ± .001.

Mill Setting for tube reclaim only, first 2 min. of test at 0.060 in. ± .001, followed by rest of test at 0.072 in. ± .001.

All timing was done with a clock with a readily visible second hand.

The reclaim was passed through the rolls at 0.072 in. setting once before the test was started. It was then returned to the bite of the rolls and the timing begun. The reclaim was brought around the front roll by hand until it knit together and no longer slipped from the roll, even at the corners. The time required to accomplish this was recorded as the Knit Time.

After the reclaim had knit together, it was cut completely from the roll with a quick horizontal cut, the cut edge being lifted from the roll and replaced before the bank disappeared from the rolls. The cutting procedure was repeated every 20 seconds until the sheet of reclaim was free of breaks or holes. This time was then recorded as the Smooth Time.

With the tube reclaim, even though it was milled more tightly for the first two minutes of the test, it was not practical to record a Smooth Time. In this case, the time recorded in parenthesis was the time at which, after cutting on the rolls, the reclaim smoothed out free of breaks or holes for a distance of approximately four inches. A check test on the next cutting of the batch was made to reaffirm the decision of the "preliminary" Smooth Time.

Williams Method (2): Five slabs of each reclaim were taken for the Williams Plasticity determination. The gravity of each reclaim was obtained. One button was cut from each slab of each reclaim at the stated aging period. Each button was cut using a cork borer which gave a button with a 1.56 c.m. diameter.

Each button was weighed for test, the weight determined by multiplying the specific gravity by two, thus resulting in a 2 c.c. volume.

The button was placed between a folded piece of paper and placed in the Williams Plastometer for three minutes at 100°C. The reading in millimeters was taken at exactly three minutes and reported after correction for thickness of the paper.

The five Williams Plasticity results were averaged for the final result.

Mooney Viscosity (3, 4): The Mooney Viscometer was operated as follows:

Approximately 100 grams of each of the five slabs representing a test reclaim were blended together on the laboratory mill by passing the reclaim through the rolls five times at a 0.250 in. setting and a mill roll temperature of 100 ± 5°F.

Two pieces of the milled blend, two inches square by one quarter inch thick, were cut, one piece was placed under the large rotor and one piece placed above the large rotor. The rotor was then inserted into the lower platen.

The platens were brought together for a one minute preheat period at 212°F and the motor started.

The result was obtained at four minutes plus and minus fifteen seconds at 212°F and the lowest figure on the gauge during this period was reported as ML4.

Two tests on each reclaim for each stated aging period were run and averaged for the final result.

Firestone Extrusion Plasticity (5): The Firestone Extrusion plastometer was operated as follows:

Approximately 100 grams of each of the five slabs representing a test reclaim were blended together on the laboratory mill by passing the reclaim through the mill rolls five times at a 0.250 inch setting and a mill roll temperature of 100 ± 5°F.

A test piece approximately four inches square by one quarter inch thick was folded once and placed between platens heated with hot water for a preheat period of six minutes at 185°F. Quarter inch spacer bars were used to prevent the press from closing completely.

At the end of the six minute preheat period the test specimen was removed from the press and placed on the lower platen of the extrusion plastometer, the two platens were brought together under 80 ± 10 pounds air pressure. After a twenty second preheat period at 175°F the test was started. The number of seconds at five pounds air pressure required to extrude the test specimen was recorded as the T-5 plasticity index.

Two tests on each reclaim for each stated aging period were run and averaged for the final result.

The Banbury Test: The factory mixing tests on the five finished reclaims were run in a 3-A Banbury with 40 RPM rotor speed and 85 pounds air pressure on the plunger. The power consumed on the DC drive motor was determined from readings of the volt and ampere meters. The batch size was first determined by trial and error and a weight of reclaim equal to 1.36 x specific gravity was found to fill the 4315 cubic inch capacity of the Banbury chamber.

All the reclaim was loaded into the Banbury at one time and a stop watch was started at the moment the plunger was lowered. Volt and ampere meter readings were recorded every 30 seconds until the power consumption had reached a constant value. This "leveling off" indicated the reclaim was plasticized and required approximately 3.0 minutes. Power consumption data were completed for all reclaims over the 3.0 minute period. It should be pointed out that this test involved no addition of pigments and therefore no conclusions on loading properties of the reclaims can be drawn from these data.

Experimental Errors

In Table II a comparison is shown of actual experimental errors typical of three methods of measuring plasticity. In the Williams method, the three worst sets of values were taken and experimental errors calculated as shown in Table II. The large probable error of single determinations made it advisable to arrive at an accurate result by averaging five determinations in each case. The source of the large error in our William tests is considered later.

With the Mooney method, reproducible results are easily obtained. We felt it necessary for the data reported in this paper to run only two check determinations following the study of errors shown in Table II.

Although the experimental error is greater with the Extrusion method than with the Mooney method, here also we decided to run only two determinations, averaging the results.

The large experimental error of the Williams method as applied here was investigated. It was found that there was a 16 per cent spread between average Y_2 values on samples taken near the edge of the slab of reclaim and those taken near the center of the slab, the higher values being obtained at the center. The reclaim at the center of the slab may receive less working in the final refining pass than at the edges of the slab because of the decreased pressure at the center of the refining rolls which are held tightly together by pressure applied at the bearings. The difference may represent a greater recovery of nerve by the center of the slab due to a higher average temperature during the first week of aging *(10)*.

Williams plasticity samples of reclaim rubber should *not* be cut directly from the finished slab of reclaim but should be obtained from a carefully blended sample as was done with our Mooney, Milling and Extrusion tests. The fact that we made five separate determinations on samples cut from five separate slabs of reclaim with no special attention to the position in the slab from which the sample was cut, and that these five determinations were averaged to give the final result, increased the accuracy of our Williams figures even though they were obtained on unblended samples.

Following the above experience, Mooney determinations (since this test is evidently the most reliable) were run on the edge and center of a slab. The results showed 21 per cent spread between edge and center of the slab. It appears therefore that even the Mooney method, which gives a high degree of reproducibility between successive tests on the same sample, is susceptible to large errors of sampling. As pointed out above, all of our Mooney and Extrusion samples were random samples from five different slabs and these were blended by milling in a standard way before the tests were run. Our two Mooney determinations generally agreed within two units. Our Extrusion results sometimes differed by 10 per cent due to the greater experimental error of the method.

In future work we recommend a minimum of five determinations by the Williams method, two determinations by the Mooney method, or three determinations by the Extrusion method, all tests to be made on five random samples taken from strips cut clear across the cut edges of slabs and carefully blended before being tested. The amount of milling must be standardized and we recommend five passes of the five blend samples through a laboratory mill opened to a 0.25 in. setting. This recommendation was arrived at after discussion of our results with representatives of other reclaiming companies.

An idea of the consistency of our Banbury measurements may be obtained from the fact that a retest of the effect of 3 minute breakdown was run on 5314 reclaim

TABLE II—EXPERIMENTAL ERRORS OF PLASTICITY DETERMINATIONS

Williams Method

Determination Number			
1	4.92	6.30	3.10
2	5.60	6.50	3.08
3	5.20	5.90	3.39
4	4.85	6.50	3.90
5	4.70	6.91	3.91
Average	5.05	6.45	3.48
Probable Error	±.08	±.09	±.10
Probable Error (Single Test)	±.17	±.20	±.23

Determination Number	*Mooney Method*	*Extrusion Method*
1	37	53
2	36	60
3	38	43
4	37	54
5	37	50
6	37	50
7	37	——
8	38	——
Average	37.3	52
Probable Error	±.16	±1.3
Probable Error (Single Test)	±.42	±2.78

using a fresh sample of reclaim. The results are as follows:

Power Consumption	
Original sample 1 week old	5.8 KW Hrs.
New sample 1 week old	5.6 KW Hrs.
Load at end of 3 minutes	
Original sample	86 KW
New sample	83 KW

In the test of the new sample the Mooney viscosity after 4.5 minutes in the 3-A Banbury was 35. The Mooney figure before Banbury treatment was 37 showing a drop of two points during 4.5 minutes in the Banbury. The temperature in the Banbury rose from 150° to 335°F during the test.

Effect of Milling or Refining

The milling or refining of reclaim increases the plasticity of the reclaim. No data have been introduced to prove this point since it has been well known for a long time. There are some reclaims which plasticize at a greater rate than others, this rate being dependent on the type of reclaim, history of the sample, and content of oils or peptizers.

Repeated refining may be used by some manufacturers to increase the plasticity of the product but this is generally an expensive process if the plasticizing can be accomplished by devulcanization with steam alone or with steam in the presence of softeners or by adding softeners after devulcanization.

All reclaims examined in this study received the standard number (two) of refining passes in their preparation with a straining operation used between the two refining passes.

Plasticity Data

We have considered first the type of reclaim exemplified by No. 5303 (peelings) which shows considerable change in its ability to break down on the laboratory mill as it becomes older in storage. This fairly rapid change is shown in Table III upon examination of the actual milling times on the laboratory mill. Within two weeks

TABLE III—PLASTICITY OF PEELING RECLAIM 5303

	Aging Period	One Day	One Week	Two Weeks	One Month	Two Months
Milling Test						
Knit Time	Min.	.4	.5	1.5	1.9	3.4
Smooth Time	Min.	1.7	1.7	2.7	3.1	4.0+
Williams Method						
Y_3	mm	5.2	5.1	5.0	5.6	5.8
Extrusion Method						
T-5	Sec.	86	64	88	88	97
Mooney Viscosity						
Mooney Units	——	46	44	49	54	65
Power Consumption						
KW Hrs.	——	——	6.5	——	7.0	6.6

TABLE IV—PLASTICITY OF AIRBAG RECLAIM 5304

	Aging Period	One Day	One Week	Two Weeks	One Month	Two Months
Milling Test						
Knit Time	Min.	.2	.25	.8	1.1	1.4
Smooth Time	Min.	.5	.4	1.0	1.3	1.6
Williams Method						
Y_3	mm	6.5	6.4	6.3	6.8	6.6
Extrusion Method						
T-5	Sec.	93	104	108	143	164
Mooney Viscosity						
Mooney Units	——	54	52	58	62	68
Power Consumption						
KW Hrs.	——	——	6.8	——	7.0	7.1

TABLE V—PLASTICITY OF TIRE CARCASS RECLAIM 5313

	Aging Period	One Day	One Week	Two Weeks	One Month	Two Months
Milling Test						
Knit Time	Min.	.8	.8	.9	.6	1.0
Smooth Time	Min.	(2.1)	(1.8)	(1.9)	(1.2)	(1.7)
Williams Method						
Y_3	mm	3.5	3.8	3.7	4.1	4.0
Extrusion Method						
T-5	Sec.	24	33	29	34	70
Mooney Viscosity						
Mooney Units	——	29	30	29	34	34
Power Consumption						
KW Hrs.	——	——	5.8	——	5.3	4.9

TABLE VI—PLASTICITY OF MODIFIED WHOLE TIRE RECLAIM 5314

	Aging Period	One Day	One Week	Two Weeks	One Month	Two Months
Milling Test						
Knit Time	Min.	.4	.35	.5	.5	.9
Smooth Time	Min.	.9	.8	1.1	1.1	1.7
Williams Method						
Y_3	mm	4.5	4.6	4.8	4.8	5.0
Extrusion Method						
T-5	Sec.	16	21	22	25	72
Mooney Viscosity						
Mooney Units	——	28	28	31	34	37
Power Consumption						
KW Hrs.	——	——	5.8	——	5.3	5.1

TABLE VII—PLASTICITY OF BUS TUBE RECLAIM 5316

	Aging Period	One Day	One Week	Two Weeks	One Month	Two Months
Milling Test						
Knit Time	Min.	1.4	1.4	1.2	1.4	1.4
Smooth Time	Min.	(5.6)	(3.7)	(3.8)	(4.0)	(3.5)
Williams Method						
Y_3	mm	2.9	3.1	3.2	3.3	3.8
Extrusion Method						
T-5	Sec.	30	14	19	38	46
Mooney Viscosity						
Mooney Units	——	27	24	26	30	33
Power Consumption						
KW Hrs.	——	——	5.6	——	5.3	5.4

the reclaim required twice as long on the mill to reach a given appearance with reference to knitting to the rolls or freedom from holes in the sheet. In two months this reclaim, judging from milling behavior, required about six times as long a breakdown period on the mill. It may be safely assumed that comparable results would have been obtained on a factory mill.

Turning next to the Williams Y_3 values we find much less indication of increased toughness although the one and two months' tests indicate some decrease in plasticity.

The extrusion test shows increased plasticity at one week followed by the toughening effect of aging showing up at two months.

The Mooney results agree with the extrusion data in showing a preliminary softening on aging followed by a definite increase in viscosity after two weeks.

This reclaim contains a substantial amount of added pine tar oil. It is thought possible that the final swelling action of the oil on tiny particles of reclaimed rubber is taking place during the first week of natural aging. No satisfactory explanation of the decreasing plasticity with age has yet been found although it has been discussed by many authors *(7, 8, 9, 10, 11)*.

In the 3-A Banbury, 5303 reclaim was broken down for 3 minutes at ages of one week, one month and two months. This reclaim came together most quickly when one month old which may account for the higher power consumption at this age. The nerve or toughness indicated by the laboratory milling test is not borne out by the 3-A Banbury breakdown tests. The reclaim consumed practically the same amount of energy after two months aging as when one week old. At the end of three minutes in the Banbury, the reclaim in all three tests was pulling a load of 110 to 130 KW indicating nearly equivalent amounts of breakdown.

Reclaim 5304 (airbags) was made by using the same process as on 5303 with more thorough heat softening of the scraps. In the milling test (see Table IV), the reclaim appears to be dead and inert and shows evidence of toughening with age, although not as much as 5303.

The Williams Y_3 values show practically no change over the two months' period. The high load of pigment is responsible for the high level of values as compared to the other reclaims.

In the extrusion test the reclaim became progressively more resistant to extrusion indicating a high resistance to a high shearing stress.

In the Mooney test, a temporary stability was indicated followed by a steady increase in viscosity, paralleling all other tests except the Williams and the 3-A Banbury tests.

In the 3-A Banbury, power consumption over a three minute breakdown period gave equal KW Hr. consumption regardless of age. At the end of the tests all three batches were drawing 100 to 120 KW. The reclaim which was one month old again appeared to knit together fastest but did not consume more power during the three minute test.

Reclaim No. 5313 (black carcass), a digester reclaim very thoroughly softened, showed a slight increase in plasticity as judged by milling tests (see Table V) over the two month period. On the other hand, the Williams Y_3 values showed a slow trend toward a decrease in plasticity.

The extrusion data, though erratic, showed an increase in nerve, especially at the end of two months.

The Mooney data indicate no substantial change in viscosity to have occurred in two months.

The Banbury data show that this reclaim consumes less power as it ages and indicate that the milling and

TABLE VIII—ANALYSIS OF SIMULATED RECLAIM VS. 5314

	Natural Rubber	Reclaim 5314
Acetone Extract	19.22	20.57
Ash	12.65	13.80
Carbon Black	19.48	19.97
Specific Gravity	1.19	1.20

Mooney tests most closely predict its behavior in a Banbury.

A standard modified tire reclaim, No. 5314, made by blending various tire scraps, was the softest reclaim tested. The milling tests (see Table VI) show significant hardening only after two months aging. The Williams figures appear high and show a steady but small increase with age.

The extrusion figures show a substantial increase in nerve at one month and a tremendous increase in the two month period.

The Mooney data paralleled the milling and Williams methods. The Banbury power consumption data show that the fresh reclaim consumed the most power, possibly because it started to knit earlier than the older reclaim, and power consumption dropped as the reclaim specimen aged.

In No. 5316, we have a typical open steam (pan) heater tube reclaim treated with strong caustic and pine tar in the heater. The milling tests (see Table VII) clearly show a progressive flattening out of the reclaim as it ages. The Williams tests indicate a steady increase in nerve. The Extrusion method shows a sharp decrease in nerve during the first week followed by a steady increase in nerve as the reclaim ages. The Mooney figures follow the same trend with less overall change.

The power consumption data show slightly more power consumed in a three minute breakdown when the reclaim is fresh with lower consumption after the two months' aging.

Power Consumption: New Rubber Versus Reclaim

Inexpensive crude rubber (roll brown crepe) was taken for a Banbury run together with sufficient clay, softening oils and carbon black to simulate the composition of 5314 reclaim. The recipe for the natural rubber compound follows:

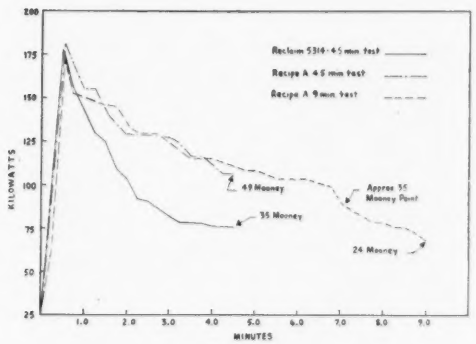

FIG. 1.

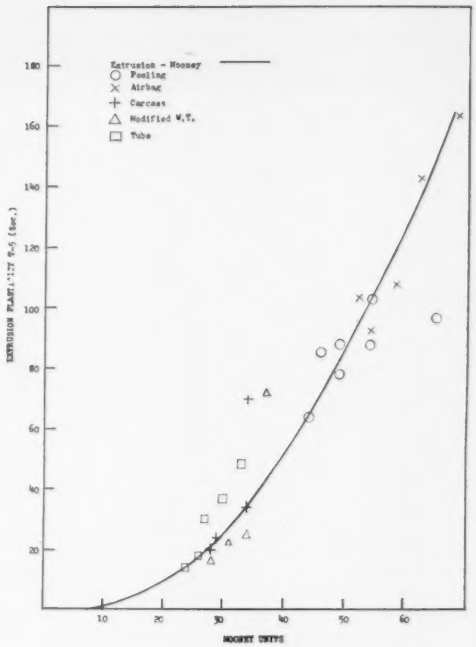

FIG. 2.

RECIPE A

Roll Brown Crepe	46
Hard Clay	17
Picco C-42 Oil	9
Channel Black	19
Paraflux	9

The material cost of this compound was practically identical with the cost of 5314 reclaim. The analysis of the resulting compound compared to that of 5314 reclaim is shown in Table VIII.

The natural rubber compound was mixed in the Banbury by charging all ingredients together and using exactly the same rotor speed as used with 5314 reclaim. The power consumption data are shown graphically in Figure 1. The power consumption for the natural rubber compound was approximately 16 KW Hrs. as compared with 7.6 KW Hrs. when both mixes reached the same KW demand. The natural rubber compound was definitely overplasticized at this point. At equivalent Mooney values, the natural rubber compound had consumed 13.7 KW Hrs., a value which is 80 per cent greater than that for the reclaim. These data give factual basis for the oft-repeated claim that reclaim consumes less power during mastication than crude rubber.

Discussion

The Milling test, although fairly widely used to evaluate reclaim because of its similarity to actual processing conditions, gives little correlation with the other methods discussed herein to measure plasticity. For example, reclaim 5304 gives the lowest milling times but the highest Williams, Extrusion, Mooney and power consumption figures. In this case, the low milling times seem to reflect the high degree of loading of the rubber in the reclaim.

Reclaim 5316 with fairly high milling times shows a high degree of plasticity in Williams, Extrusion, Mooney and power consumption tests. This tube reclaim is very plastic but has elastic properties which show up in the milling test.

Thus, it seems that the milling test is primarily a measure of the elasticity of the reclaim rather than the plasticity. Since there is no standard laboratory mill, it is doubtful if the milling test can ever become a standardized test. It must be admitted that the milling test gives some information not brought out in the plasticity tests in this paper.

There is a relationship between the Mooney results and the Extrusion results shown in Tables III to VII. These data are plotted in Fig. 2. Since both types of units are in general use, it is interesting that there is a fairly consistent relationship between them, at least in the lower Mooney range considered herein. Deviations from the curve in Figure 2 were greatest when the reclaims had been aged two months. The Williams data are not sufficiently reliable due to the experimental errors discussed above to show a clear cut relationship with the corresponding Mooney results. An inspection of the tables, however, indicates that high Williams values generally correspond with high Mooney values.

Summary

(1) The Mooney Viscosity method of measuring plasticity of reclaimed rubber is more accurate than the Williams or Extrusion methods.

(2) Mooney and Extrusion results in reclaimed rubber appear to be related.

(3) The milling test measures some other property of reclaimed rubber, probably elasticity.

(4) Plasticity tests on reclaimed rubber should be run on a blend of several samples. It is recommended that such samples be taken clear across the cut edge of the slabs of reclaim because the plasticity may vary from center to edge of the slab. Duplicate determinations are sufficient with the Mooney Viscometer but the other methods require additional tests in order to obtain accurate results.

(5) Reclaims made in the neutral, open steam process, upon aging showed increasing breakdown times on the laboratory mill with relatively little change in plasticity as measured by Williams, Mooney or Extrusion methods. Alkali-digester or alkali-open steam heater reclaims showed a decrease in milling time, little change in Mooney viscosity, or extrudability through one month's aging.

(6) Five types of reclaimed rubber showed little or no increase in power consumption in a 3-A Banbury after two months' natural aging.

(7) A typical modified whole tire reclaim consumed about 60 per cent as much power when masticated in a 3-A Banbury to the same plasticity as a natural rubber compound of the same cost and analysis.

(8) It is believed that no single test can replace both milling and plasticity tests and it is suggested that milling and Mooney tests used in conjunction with each other offer the maximum amount of information about the workability of reclaimed rubber.

ACKNOWLEDGMENT

The writers wish to thank Messrs. Owen Horner, William Maple, and David Glenny for assistance in accumulating the data. They also wish to thank the Xylos Rubber Company and the Firestone Tire and Rubber Company for permission to publish the data.

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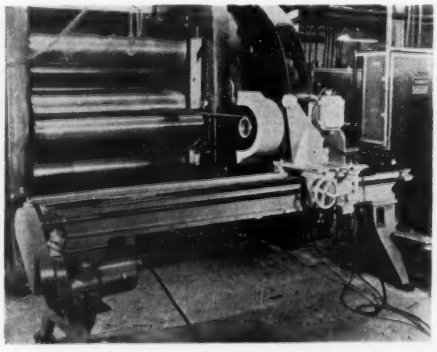
Ryman Integral Roll Grinder

Embodying an entirely new principle of roll grinding, the Integral Roll Grinder introduced by the Ryman Engineering Co., Elwood City, Penna., permits the grinding of rolls, such as used in the manufacture of rubber and plastics, without removing them from their respective machines. The unit features precision grinding with abrasive belts with a degree of accuracy comparable with or greater than the usual type of wheel grinders. The unit comes in two models, the "in-machine" unit, depicted herewith, and an "out-machine" Integral grinder, where rolls are taken from their machines and brought to the grinder.

The Integral Grinder is said to have complete insensitivity to vibration. Abrasive belts are the cutting medium, and changes in belt do not involve any balancing procedure as in the case with wheels. Changes in grades of abrasives are therefore easily made. The problem of aligning the machine is reduced to a minimum. It also permits the grinding of heated rolls and the cylinders with no disturbance of grinder alignment. The absence of ways also eliminates the need for a massive bed, which coupled with the ease of alignment permits "field" or "in-machine" grinding of rolls and cylinders.



Division of High-Polymer Physics, A. P. S., Meets in New York City on February 2, 3, and 4

THE annual meeting of the Division of High-Polymer Physics of the American Physical Society will be held in New York City on Thursday, Friday and Saturday, February 2, 3 and 4, in conjunction with the 297th Annual Meeting of the parent society. Headquarters for the parent society will be the Pupin Physics Building of Columbia University.

The meeting of the Division of High-Polymer Physics will feature the presentation of 28 technical papers, including a five-paper symposium on "Stress Phenomena from the Respective Viewpoints of Solid-State and High-Polymer Physics." The symposium will be held on Friday morning, February 3, at Columbia University, with W. L. Davidson (B. F. Goodrich Research Center) presiding and M. L. Huggins (Eastman Kodak) acting as discussion leader. All other sessions of the Division will be held at the Polytechnic Institute of Brooklyn in Brooklyn, N. Y. A business session will be held on Thursday afternoon, February 2.

Dr. Davidson is program chairman for the three-day meeting of the Division of High-Polymer Physics. Dr. W. J. Lyons, of the Firestone Tire & Rubber Co., Akron, is secretary of the Division. Abstracts of the papers follow:

ABSTRACTS OF PAPERS

Thursday Morning—February 2

Incubation of Plastic Shocks in Certain Polymeric Films. ***John Kauffman and Waller George (Naval Research Laboratory, Washington, D. C.).***

The existence of a time delay between the rapid application of a load and the appearance of plastic flowing has been demonstrated in mild steel by Clark and Wood (A.S.T.M. Preprint No. 25, June, 1949). P. W. Bridgman has also called to the attention of the authors his observation of similar effects in higher alloyed steels (*J. App. Phys.*, Vol. 17, p. 225, 1946). Recently, the authors have discussed a similar time delay for the appearance of a form of localized plastic flowing in commercial polyamide films [*Bull. Phys. Soc.*, Vol. 24 (7), No. 30 (A), Nov., 1949].

The localization involves a thickness reduction of the specimen (a type of local necking) which can be made to propagate along the specimen. It has been tentatively interpreted in terms of von Karman's plastic wave theory as a "plastic shock" (N.D.-R.C., A-29, OSRD, 365, Jan., 1942). Under suitable dead weight loading the "shock" is observed to propagate after the elapse of the delay time. Plastic flowing events occur within this delay time which lead to the abrupt formation of the shock. The collection of these events preceding the final localization of flowing is termed its "incubation."

This paper will describe the incubation processes with the aid of motion pictures and polarized light for selected polyamide and polyethylene films. The description will include the initiation and growth of "bands" of distortion in regions of maximum average shear stress and their collapse into the fully formed shock.

Fracture Markings in Plastics. ***J. A. Kies and A. M. Sullivan (Naval Research Laboratory, Washington, D. C.).***

Many of the gross features of fracturing in solids can be modeled and chosen features can be emphasized on fractures in selected polymeric solids. Discontinuous fracture and backwards propagation of isolated elements simultaneous with the advance of the crack head are demonstrated. The origins of chevrons and other geometrical markings, such as ellipses, hyperbolas and river systems on the fracture surface, are explained in terms of multiple initiations and relative propagation speeds of fracturing.

The sequence of events by which rod-shaped shards are thrown out during conchoidal fracturing is described. Shatter markings provide a mechanistic explanation of brittle behavior under high overloads. Variations of fracture appearance with overall speed of propagation in cellulose acetate and Lucite plates are discussed. A few examples of the applicability of these studies to the interpretation of some large scale fractures in various materials are cited.

Crystallization and Second-Order Transitions in Silicone Rubbers. ***C. E. Weir, W. H. Leser and L. A. Wood (National Bureau of Standards, Washington, D. C.).***

In the course of an investigation to determine which rubbers might be suitable for use at low temperatures, interferometric measurements of the length-temperature relationships of silicone rubbers have been made. Crystallization was found between —60° and —67°C. in Dow-Corning Silastic X-6160 and in General Electric 9979G silicone rubber, the latter of which contains no filler. Crystallization between —75° and —85°C. was found in Silastic 250. Melting occurred over a range of temperature above the temperature of crystallization. The volume change on crystallization varied from 2.0 to 7.8 per cent. No crystallization or melting phenomena were observed in Silastic X-6073 between —180° and +100° C. All types of silicone rubber exhibited a second-order transition at about —123° C., the lowest temperature at which such a transition has been observed in a polymer. The coefficient of linear thermal expansion of silicone containing no filler was found to be about 40. x 10^{-5}/deg. C. between —35° and 0° C. [The work reported here was supported by the Office of Naval Research and the Office of the Quartermaster General as part of Project ONR (QMC) NR-033-314].

Random Noise in Dielectric Materials. ***R. F. Boyer (Dow Chemical Co., Midland, Mich.).***

When thin films of various polar plastic materials are used as the dielectric medium for condensers in a high gain circuit whose output is fed to a Brush recording oscillograph, the application of direct current voltages of the order of 100 volts per mil across the specimen gives rise to two effects. First is the usual rapid exponential decay in current associated with charging current effects, then random bursts of current. These random bursts are believed to be a new effect. The frequency of these random bursts and their amplitude decrease with time and they finally disappear. Reversal of the current causes the phenomenon to reappear.

Polystyrene and polyethylene do not show this effect. Copolymers of vinylidine chloride with 20 to 40 per cent acrylonitrile are quite spectacular. Most polar polymers, such as nylon, plasticized polyvinylchloride, Saran, paper, and cellulose derivatives, have a characteristic pattern. The effect may result from ionic impurities which undergo an "activated diffusion" process whenever a hole opens between polymer chains. The process would then be analogous to the activated diffusion of water molecules. The process stops when the ions are all driven to one electrode and will start again on reversing the polarity. Brass electrodes show these effects quite well, silver not at all, and aluminum only slightly. There is a further analogy between this phenomenon and the "avalanches" observed with crystal scintillation counters.

Equivalent Effects of Time and Temperature in the Shear Creep and Recovery of Elastomers. *F. S. Conant, G. L. Hall and W. James Lyons (Firestone Tire & Rubber Co., Akron, Ohio).*

An explicit relationship is set forth for the time-temperature dependence of the visco-elastic phenomena in the superelastic polymers. An empirical equation that was found to represent adequately the above-mentioned relationship over the entire multiple-temperature curve is of the form:

$$\log t = \frac{C_\alpha}{T - b} + C_\beta \bullet$$

Experimental verification is given for the equivalent influence of time and temperature on the creep and recovery of compounds based on Hevea, GR-S, Neoprene GN, Butaprene and Butyl rubber. A comparison of the empirical equation with that of a theoretical reaction-rate equation of Tobolsky and Eyring indicates a temperature dependence of the energy of activation.

Thursday Afternoon—February 2

Elastoviscous Properties of Polyisobutylene. III. Relaxation of Stress in Whole and Fractionated Polymers; Effect of Carbon Black. *R. D. Andrews, F. H. Holmes and A. V. Tobolsky (Princeton University, Princeton, N. J.).*

Relaxation of stress at constant strain in polyisobutylene has been examined over wider ranges of elongation, temperature, and molecular weight than in previous studies. A stress-strain curve of polyisobutylene elasticity has been constructed from relaxation data at different elongations.

In polymers of very high molecular weight, the relaxation regions corresponding to "high temperature" and "low temperature" relaxation processes (the latter being observed in these experiments at temperatures of —30°C. and below) are almost completely separated experimentally. At a temperature of —20°C. very high molecular weight polymer appears in these experiments to be in a pseudo-equilibrium elastic state, with little relaxation observed over a considerable time interval. These data indicate the presence of a temporary network structure in this polymer, chain entanglements presumably acting as temporary cross-links between molecules.

Apparent activation energy for relaxation is found to be a function of temperature, its value decreasing with increasing temperature. A power law expresses the relation between relaxation rate and molecular weight more accurately than the molecular weight relation proposed in Part I of this series.

Fractionation appears to narrow to some extent the distribution of relaxation times which corresponds to the relaxation curve. Inclusion of carbon black in polyisobutylene causes a change of shape of the relaxation curve. Evidences of crystallization are observed at —30°C. in a polymer containing carbon black, at relatively moderate extensions. The applicability of the "Principle of Superposition" to the elastoviscous behavior of polyisobutylene has been investigated by means of two-elongation relaxation experiments.

Non-Destructive Mechanical Test for Wool Fibers and Some Preliminary Results. *M. Burte Harris (Textile Research Institute, Princeton, N. J.).*

The slope of the force extension curve in the linear region before the yield point can, for wool fibers, be non-destructively measured at five- to ten-minute intervals. The change of this slope with time is used to follow the course of the heterogeneous reaction between wool and some reagent. Woods [*Proc. Leeds Phil. and Lit. Soc. (Sci.)*, Vol. 3, p. 577 (1940)] determined the dependence of Young's modulus on relative humidity, but did not investigate any rate phenomena.

Data are presented on the interaction between concentrated aqueous solutions of neutral salts and wool fibers. Two processes occur: (a) Relatively rapid hydration or dehydration of the fiber until equilibrium with the partial pressure of water over the salt solution is attained; (b) Relatively slow absorption of salt ions by the fiber.

Very concentrated salt solutions dehydrate the fiber so completely that absorption of salt ions is not possible. Swelling experiments, and experiments involving other mechanical properties, confirm this view. The interaction between wool fibers and aqueous solutions of large organic molecules follows a similar pattern. The effect of fiber size and type on the rate of absorption has been studied. The absorption of ions is probably diffusion rate controlling.

Some Theoretical Considerations of Dynamic Property Data on Textile Specimens. *W. James Lyons (Firestone Tire & Rubber Co., Akron, Ohio).*

Early stretch-vibrometer data, of quite extensive character, on the frequency dependence of the internal friction μ of a nylon monofil, has been found to conform to the relation:

$$\mu = \frac{\mu}{1 + \omega^2\tau_2^2} + \mu^3$$

which was deduced independently by Tobolsky and Eyring from considerations of molecular structure. Among other constants evaluated was the relaxation time for the secondary-bond network τ_2, which was found to have the value 9.3 sec.

By more sensitive graphing methods than had been used heretofore, it was confirmed for the nylon data that the hyperbolic relationship between resonant frequency ω_0 and internal friction μ holds equally as well as the foregoing equation. The two relationships are shown to be nearly equivalent in the experimental range. On evaluation of graphical parameters, the equation

$$\mu\,\omega_0 = 2.47 \times 10^9 \text{ ergs/cm}^3$$

was obtained.

Using the same graphical method with a set of data on 11/4/2 cotton cord the relation

$$\mu\,\omega_0 = 7.05 \times 10^8 \text{ ergs/cm}^3$$

was established.

Fundamental Studies of Plasticization of Polyvinyl Chloride. *M. L. Dannis (B. F. Goodrich Co., Brecksville, Ohio).*

The softening of a hard resin, polyvinyl chloride, by a liquid, dioctyl phthalate, occurs through a set of processes in sequence. Imbibition of the liquid is accompanied by volume reduction in the system. Dilatometer methods evaluate the amount and rate of volume decrease. The rate is temperature dependent, activation energy about 80 k cal. Solution of liquid into the resin follows with no further volume, but large dielectric change. Dielectric changes are measured on material in a cylindrical condenser, using a Schering bridge, and are rate dependent, activation energy about 110 k cal. Data are best described, assuming that segments of the polymer molecule "react" independently of one another.

At fixed temperatures, "reaction" rates are directly proportional to vapor pressure of the liquid. The dielectric change may be treated similarly to a chemical reaction between a solid and a vapor, and free energy of activation, ΔF^{**}, evaluated. ΔF^{**} is constant for various liquids with one resin. $\Delta E^{**} = \Delta H^{**} + L$ in this system, where ΔE^{**} is Arrhenius activation energy, ΔH^{**} energy barrier, and L latent heat of vaporization of the liquid.

Load Induced X-Ray Line Broadening in Nylon Filaments. *Waller George and John Kauffman (Naval Research Laboratory, Washington, D. C.).*

The load induced microscopic structural changes in highly oriented nylon filaments were followed by changes in the X-ray fiber diffraction pattern as a function of the resulting strain. Observations made include (1) changes in the dimensions of the fiber spots, and (2) a decrease in ratio of the intensity of amorphous to crystalline X-ray scattering. These new results for Type 200 DuPont nylon indicate a change in the micro deformation mechanism at a strain corresponding to the inflection of the load-strain diagram (14% elongation). The mechanism for smaller plastic strains appears to involve a rotation of the crystallized domains toward alignment with the fiber axis, accompanied by a small over-all additional crystallization. For strains larger than the inflectional strain, the mechanism seems to involve a progressive reduction in the domain size, and a reduction in alignment with the fiber axis. Both effects appear to saturate in the vicinity of the rupture strain. These results are discussed in terms of load induced effects found in metal single and polycrystals. It is suggested that the qualitative features observed may be representative of a wide class of load or strain induced micro deformation reactions in the solid state.

Friday Morning—February 3

The following papers will be presented at the Symposium on Stress Phenomena to be held at Columbia University. Abstracts of the papers are not available at this writing. The papers are:

Mechanism of Plastic Flow in Single Crystals. ***Frederick Seitz (University of Illinois, Urbana, Ill.).***
Structure and Physical Properties of Crystalline Polymers. ***Herbert Leaderman (National Bureau of Standards, Washington, D. C.).***
Rheological Properties of Glass. ***W. A. Weyl (Pennsylvania State College, State College, Penna.).***
Internal Friction in Solids. ***Clarence Zenar (University of Chicago, Chicago, Ill.).***
Static and Dynamic Viscosities of Amorphous Polymers. ***A. V. Tobolsky (Princeton University, Princeton, N. J.)***

Saturday Morning—February 4

Emulsion Polymerization with Ultrasonic Vibration. ***A. S. Ostroski and R. B. Stambaugh (Goodyear Tire & Rubber Co., Akron, Ohio).***

Emulsion-type polymerization reactions have been accelerated by irradiation with ultrasonic energy.

A magnetostriction oscillator at 15 KC gave essentially the same results as a piezoelectric oscillator at 500 KC. The rate of formation of polystyrene was doubled and higher final yields obtained using about .03 watts of vibrational power per cc of latex. Experiments were made to separate local heating effects from the pure vibration energy.

A thermostatted stainless steel cell was developed for irradiating butadiene emulsions under pressures up to 60 p.s.i. About ½ watt of vibrational power per cc of latex doubled the rate of reaction for GR-S, Redox and Redsol formulas.

The ultrasonic intensity apparently must exceed a critical value before any appreciable accelerative effect is observed. The time to reach a given yield of polymer is approximately inversely proportional to the power used.

Rotating Specimen Mount for Use with X-Ray Spectrometer in Measuring Crystallite Orientation of Cellulose and Other Textile Fibers. ***Leon Segal, Joseph J. Creely and Carl M. Conrad (Southern Regional Research Laboratory, New Orleans, La.).***

The quantitative evaluation of crystallite orientation in textile fibers by X-ray methods is discussed. It is found that photographic recording and photometering of the resulting films can be replaced by automatic recording on a strip chart with the aid of an X-ray spectrometer with Geiger-Müller counter. The design and details are given for a specimen holder capable of properly positioning and rotating a bundle of fibers in the X-ray beam so that the 002 or other selected diffraction arc passes before the window of the counter. A tentative procedure is outlined for evaluating, with the aid of this apparatus, the crystallite orientation of a bundle of cellulose fibers. Some typical recordings of the intensity curves of the 002 arcs from ramie, cotton and high-tenacity rayon are presented.

On Crazing of Linear High Polymers. ***C. C. Hsiao and J. A. Sauer (Pennsylvania State College, State College, Penna.).***

The effect of various variables, such as type of stress, stress magnitude, duration of stressing, and environment, on the initiation and development of crazing in linear polymers is discussed. The basic nature of crazing is investigated in some detail for polystyrene specimens by means of the light microscope, the electron microscope and the X-ray spectrometer. The results of these observations and their bearing on the fundamental group structure of the polystyrene molecules is presented.

The relationship between crazing and orientation is discussed, as well as the effect of both of these factors on the mechanical properties. The experimental results are compared, wherever possible, with the previously reported data of other investigators. A short discussion is then given of a theory of crazing from the point of view of the molecular structure of the material.

Equation of State for High Polymers. ***R. S. Spencer and G. D. Gilmore (Dow Chemical Co., Midland, Mich.).***

In a former paper (*J. Applied Phys.*, Vol. 20, p. 502, 1949), the authors suggested the following equation of state,

$$(P + \pi)\ (V - \omega) = RT,$$

where π is the internal pressure (or cohesive energy density) and ω is the volume at absolute zero. It was found that this equation was in good agreement with data on the thermal expansivity and isothermal compressibility of polystyrene.

The present paper reports isothermal compression measurements on polymethyl methacrylate, polyethylene, cellulose acetate, and ethyl cellulose, within the fabrication range of temperature. The above equation of state is shown to apply equally as well to these thermoplastics as to polystyrene and values are given for the constants π and ω. The usefulness of this relationship is illustrated in a brief discussion of some phases of the injection molding process.

Behavior of Granulated Polymers Under Pressure. ***R. S. Spencer, G. D. Gilmore and R. M. Wiley (Dow Chemical Co., Midland, Mich.).***

In such fabricating processes as extrusion and injection molding it is frequently necessary to force a granulated polymer through a channel. Frictional forces between polymer and channel walls lead to a drop in pressure through the granular material. Simultaneously, the applied pressure causes a compaction of the granules.

Assuming that the granular mass has certain fluid-like properties, a simple theoretical expression for pressure transmission is derived. Comparison with data on Saran powders and granular polystyrenes shows good agreement between theory and experiment. The effect of lubrication is shown also.

The compaction of granular polystyrene follows the same pattern as that observed in the earth's crust. The porosity decreases exponentially with increasing pressure. The "compressibility coefficient" for the porosity of granular polystyrene is comparable with that given for clays and shales.

Saturday Afternoon—February 4

Mechanical Properties of Oriented Polystyrene Films. ***Lawrence E. Nielson and Rolf Buchdahl (Monsanto Chemical Co.).***

Cast films of polystyrene were oriented by stretching at temperatures above the softening temperature of the material and then cooled. A factorially designed experiment was carried out in which the amount of stretching, temperature of stretching, time held in the stretched state before cooling, and effect of several cycles of stretching before cooling were investigated as they affect the birefringence, the stress-strain properties, dynamic modulus and damping, and the softening temperature of polystyrene.

In general, the value of the stress-strain properties (modulus, elongation to break, and ultimate strength) in the direction of stretch, the dynamic modulus, and the birefringence all increase with an increase in the amount of stretching, a decrease in temperature, an increase in rate of cooling after stretching, and a decrease in the number of times the film was stretched before finally cooling. The values of many of the mechanical properties are more closely related to the birefringence than to the amount of hot stretching. The softening temperature is decreased in direct proportion to the birefringence. Annealed films give higher softening temperatures than films which have been stretched and then allowed to shrink before cooling.

The Transition Phenomenon of Polymeric Substances. ***R. Buchdahl, L. E. Nielson and R. E. Pollard (Monsanto Chemical Co.).***

The mechanical properties of high polymers are determined by the location of the transition range on the temperature scale; the transition region is defined as the temperature range where the mechanical loss factor goes through a maximum and where the dynamic elastic modulus changes by several decades. Below the transition temperature the polymer is a rigid brittle solid and above this temperature the polymer is a rubber-like mate-

rial. The addition of low molecular weight plasticizer to the polymer lowers the transition temperature and changes the width of the transition.

Quantitative changes of the transition temperature will be explained in terms of plasticizer concentration, compatibility of the plasticizer-polymer system and in terms of a transition in the plasticizer. For copolymers the transition range can be predicted from the volume of the two components and their respective transition temperatures. The behavior of polymer blends in terms of the transition phenomenon is discussed briefly and a possible interpretation of the general transition phenomenon will be given.

Dispersion of Dynamic Rigidity and Viscosity in Concentrated Polyvinyl Acetate Solutions. ***John D. Perry, W. M. Sawyer, George V. Browning and Arthur H. Groth, Jr. (University of Wisconsin, Madison, Wisc.).***

Data for the dynamic mechanical properties of solutions of polyvinyl acetate in 1, 2, 3-trichlorotropane, obtained from both transducer and wave propagation measurements, superpose for all concentrations from 5 to 40% and all temperatures from −3° to 41°C. when the reduced dynamic rigidity, $G'T_s/T_c$ and the reduced frequency, $\omega\eta T_s/T_c$; G' = real part of complex dynamic rigidity, η' = real part of complex dynamic viscosity, η = steady flow viscosity, c = concentration in g./cc., T = absolute temperature, $T_s = 298°K$. This behavior can be predicted by postulating that each elastic mechanism has a rigidity proportional to T and to c and that the relaxation times of all mechanisms have the same dependence on c and T. The two universal dispersion curves are characteristic of a given polymer sample, representing the mechanical properties in a hypothetical standard state of unit density and unit viscosity at 298°K. From either dispersion curve, the distribution of relaxation times may be obtained over about 5 cycles of logarithmic time. The distribution indicates a relatively sharp cutoff at the upper end which may be attributed to the finite molecular length of the linear polymer.

The Effect of Excluded Volume on the Configuration of Long-Chain Molecules. ***Gilbert W. King (Arthur D. Little, Inc., Cambridge, Mass.).***

The effect of excluded volume on the configurations of simple chains has been studied by carrying out random walks in a 3-dimensional tetrahedral lattice, using punched-card machines. Excluded volume was taken into account by comparison of coordinates of all steps in each walk and rejection of equals. The frequency and position along the chain of closure was noted.

On very general grounds, it can be shown that the number of configurations of a chain of Z links with excluded volume is $F_x(Z) = \gamma^z G(Z)$ where G(Z) is no stronger than a polynomial. This suggests the definition of an effective coordination number

$$\gamma(Z) = \gamma\, G(Z)^{1/Z} = 3H(Z)$$

$$H(Z) = h_1(Z)h_2(Z) \ldots h_Z(Z).$$

The correlation numbers $h_n(Z)$ are the probabilities of the Z'th link surviving by not occupying the lattice point of the n'th link (counted from the end). It is shown that $h_n(Z)$ is independent of Z, for reasonably large Z, and that in the limit of large n, $h_n(Z) \to 1$. In general $h_n(Z) = h_n = \exp(-\frac{3}{4}n^2)$. This gives a value of the limiting coordination number of 2.86, and also affords a distribution function of side groups on a polymer growing with unspecific chain transfer.

Concentration Dependence of Viscosity of Solutions of Macromolecules. ***Jacob Riseman and Robert Ullman (Polytechnic Institute of Brooklyn, Brooklyn, N. Y.).***

The method of Kirkwood and Riseman, used to account for hydrodynamic interaction between elements of the same chain, is extended to include interactions between elements of different chains, responsible for the hydrodynamic effects leading to the concentration dependence of viscosity. The dumbbell and rod-shaped molecule will be treated. Smolochowski's result for pair interaction appears as a first-order approximation. The viscosity calculation is carried out by considering the average shearing stress across a plane and yields for the viscosity a generalized binomial form,

$$\eta = \eta_0/1 - f(c).$$

f(c) depends on the distribution function of elements on the same and different chains. At low concentrations, a uniform distribution has been assumed, leading to a $k' [\eta]^2$ as the coefficient of the c^2 term. A method of iteration would give f(c) as an infinite power series in the concentration, and the corresponding viscosity as a doubly infinite power series. The generalized binomial form thus obtained therefore bears some resemblance to empirically proposed equations for the viscosity.

The Stress-Strain Behavior of Thermally Shortened Collagen Tendons. ***Norman M. Wiederhorn and Gerald V. Reardon (United Shoe Machinery Corp., Boston, Mass.).***

In order to gain information concerning the structure of collagen, the stress-strain behavior of thermally contracted (denatured) kangaroo tail tendon was studied. It has been determined that when this material is highly swollen with appropriate swelling agents it obeys the kinetic theory of rubber elasticity for relatively large deformations. The material is apparently cross-linked by covalent linkages and the average molecular weight of the chain between points of crosslinking has been determined to be 54,000 ±7,000. This corresponds to approximately 600 amino acid residues, so that the concentration of amino acids involved in crosslinks is of the order of 0.2%.

Molecular Weights from Flow Birefringence and Intrinsic Viscosities. ***M. D. Schoenberg and F. R. Eirich (Polytechnic Institute of Brooklyn, Brooklyn, N. Y.).***

An empirical relationship is proposed relating the quotient $(n_s - n_s)/q\eta_s C$ to the molecular weight and intrinsic viscosity. The constant obtained for a single fraction in a given solvent from experimental flow birefringence and intrinsic viscosity data, when applied to flow birefringence and intrinsic viscosity measurements on other fractions of the same polymer in the same solvent, gives molecular weights that are in agreement with those obtained by other measurements. The molecular parameters b and ζ are obtained by calculating the rotatory diffusion constant of Riseman-Kirkwood.

At large gradients the above relationship no longer is applicable, which effect is attributed in part to a "stretching" phenomenon.

Letters to the Editor

Dear Sir:

I note in the October, 1949, issue of your Journal that the Buffalo University claims to possess the smallest rubber mill in the world, the rolls of which are 4 inches long and 1½ inches in diameter.

It may interest you to know that in 1927 my father presented me on my birthday with a specially made rubber mixing mill. This mill had rolls 1⅜ inches in diameter, the distance between the cheek plates being 4¼ inches. The mill was fitted with a large hand wheel, and provided me in my 'teens with a fair measure of physical exercise and, I hope, some education.

In 1934 this mill was motorized and mounted on a substantial steel stand, the power being supplied by a ¼ h.p. motor. Since that date it has been in continual use in our laboratory, where it must have compounded some hundreds of sample batches. A few weeks ago the gears gave up the ghost—the first breakdown in 22 years. A new set of gears is now being made, and we expect that very shortly the veteran will go back into service.

Yours truly,

L. Landau

London Rubber Co.
North Circular Road
Chingford, London E.4, England
November 9, 1949

Editorials . . . . . .

Prospects for 1950

OPTIMISM keynoted the annual statements of many rubber industry officials in their forecasts of business prospects for 1950. The general agreement was that industry sales in 1950 would compare favorably with the $3,000,000,000 total set in 1949. Examination of general business conditions would seem to indicate that the American people will continue to have great purchasing power due to full employment at relatively high wages. Rubber consumption in the United States in 1950 is estimated at approximately the same tonnage as used in 1949. This amount was approximately 985,000 tons, of which 575,000 tons were natural rubber and 410,000 tons synthetic. Total consumption in 1948 was 1,069,000 tons. It is estimated that the United States in 1949 consumed 52% of all the rubber consumed in the world. Per capita consumption in this country was 15 pounds, ten times the average for the world.

Tire replacement sales during 1950 should approximate or exceed the figures established in 1949. The replacement of tires on the millions of automobiles produced in 1946, 1947 and 1948, should be a major factor in these estimates. Sales of replacement truck tires should exceed 7,000,000 units, an increase of 4% over 1949 figures, while 5% greater sales of replacement tires for agricultural use is anticipated in 1950. Recent price rises in original equipment and replacement tires have ameliorated some of the hardships suffered by many tire manufacturers. It is interesting to note that despite these recent price rises, the popular 6.00 x 16 four ply tire still costs consumers less than it did a year ago, and only 2% more than in 1939. This fact is particularly enlightening since production costs have increased greatly and the present day tire is a heavier, more serviceable product.

Industrial rubber products, including hose, belting, packing, etc., should be in strong demand in 1950 in line with the general high level of business. Foam rubber production will be expanded further to meet the growing demand for foam bedding and cushioning. It is also expected that the 190,000,000 pounds of polyvinyl plastics produced in 1949, will be exceeded by 1950 totals.

Of course, many external factors will contribute to the general business picture for the rubber industry in 1950. General economic conditions, foreign relations, and new scientific developments all have a bearing on the situation. Disputes between labor and management could adversely affect a smooth flow of production and upset the economic stability of the industry. All factors considered, however, the year 1950 should bring substantial advances and prosperity to the rubber industry.

Patent Pooling

THE recent Government decision to end wartime patent pool arrangements among companies developing synthetic rubber has met with the general approbation of industry. The pooling agreement, which provided for exchange of information and patent pooling in the development of synthetic rubber, was signed in December, 1941, by six companies —Goodyear, Goodrich, U. S. Rubber, Firestone, Standard Oil Development Co., and the Phillips Petroleum Co. Under the arrangement, all technical developments and patents in connection with the expanding program of synthetic rubber development were sent to the Government, which distributed the data among other signatories. All patents and procedures in joint use up to March 31, 1949, remain the common property of the pool participants. It can not be doubted that the mechanics of patent pooling provided a necessary and patriotic function during and immediately after the war. In accordance with American economic thinking, however, many in the industry were of the opinion that the best interests of the industry and the people of the United States called for a return to competitive conditions. Most industry spokesmen viewed the end of patent pooling as a spur to increased research and development in synthetic rubber. Others were of the opinion that the only step left for the Government to take was to discontinue the manufacture of synthetic rubbers.

CURRENT NEWS OF THE MONTH

RUBBER INDUSTRY OPTIMISTIC OVER PROSPECTS FOR NEW YEAR

Rubber industry heads in the United States are generally optimistic over business prospects for 1950. Annual year-end statements predicted sales averaging or exceeding totals reached in 1949. Harry E. Humphreys, Jr., president of the U. S. Rubber Co., stated that tire sales for 1950 are estimated at 80,000,000 units, about equal to the 1949 total. It is possible that original equipment business might fall off, he said, but replacement sales should hold up well.

John F. Collyer, president of the B. F. Goodrich Co., concurred in this view. He said that sales to replace wornout tires on the millions of automobiles produced in 1946, 1947 and 1948, should be a major factor in the higher tire replacement sales anticipated in 1950. The American tire industry can expect at least a 5% sales increase in passenger car replacement tires, he said.

J. P. Seiberling, president of the Seiberling Rubber Co., also foresaw a bright future in the replacement market. He expects tire replacement sales volume for the industry to be up 6 to 8% in the first-half of the year, compared with the first half of 1949. Truck tire sales should be even better, he said, 10 to 12% over the first-half of 1949 in the replacement field. Farm tire replacement sales, which were disappointing in 1949, should be up about 10%, and recapping ought to continue at its present high level.

Consumption of Rubber

Rubber consumption in the United States in 1950 is estimated at approximately the same tonnage as used in 1949. This amount was about 985,000 tons, of which 575,000 tons were natural rubber and 410,000 tons synthetic. Mr. Collyer noted that the demand for rubber products continues strong on all fronts, and industry-wide consumption of rubber will be about 935,000 tons.

Mr. Collyer observed that the recovery from the effects of the recent war can be gauged in part by the volume of rubber being consumed throughout the rest of the world. Consumption outside the United States increased from 831,000 long tons in 1948 to an estimated 893,000 tons in 1949. This gain is expected to continue into 1950 with an estimated 920,000 tons being consumed by the rest of the world. Worldwide consumption of rubber in 1949 is estimated at 1,870,000 long tons, Mr. Collyer said, which is an increase of 62% over the 1,150,000 tons consumed in 1949.

Harvey S. Firestone, Jr., chairman of the Firestone Tire & Rubber Co., said that it is, of course, impossible to predict with any degree of accuracy many of the things that will actually happen in the rubber industry during the next 50 years. Too many external factors, such as international affairs, general economic conditions and new scientific developments are involved. However, in looking back over the accomplishments of the last 50 years, he expressed confidence that progress during the next half century will be equally impressive.

For his part, Mr. Humphreys observed that the rubber industry is the only major manufacturing industry still under wartime controls. The industry is required by the Government to consume synthetic rubber at the minimum annual rate of 222,000 tons, he said. However, the industry every year since the war has used more synthetic than required by law. Consumption in 1949 was 188,000 tons above the Government requirement.

Mr. Humphreys said that the U. S. Rubber Co. takes the position that the Government should get out of the rubber business because the present controls are unnecessary. He believes that the synthetic industry will progress faster and operate more efficiently when freed of Government regulation and turned over to private management.

Expansions in the chemical and plastics fields were predicted by Mr. Collyer. An estimated 190,000,000 pounds of polyvinyl plastics were manufactured in this country in 1949, he said, a portion of which has been made into industrial and consumer products once manufactured exclusively from rubber. The automobile industry is using vinyl plastics in increasing volume for seat upholstery, kick pads, etc.

Test Water-Filled Tires

Experiments in the use of auto tires filled with water instead of air are being made by a Liverpool, England, trucking company. Aimed at increasing tractive effort by trucks drawing heavy trailers, the new technique is claimed to minimize wheel spin and skidding, improve braking and acceleration and cause less wear on the tires. In the tests, rear tires are inflated with 20 gallons of water, mixed with calcium chloride. After one experimental test a water-filled tire showed five milimeters wear in 12,000 miles, compared with nine to ten millimeters for air-filled tires which covered the same mileage.

WARTIME PATENT POOLING ON SYNTHETIC RUBBER CONCLUDED

The Reconstruction Finance Corporation, Washington, D. C., has announced the end of wartime patent pool arrangements among firms developing synthetic rubber. The agreement was terminated in line with directives of the Rubber Act of 1948. The pooling arrangement, which provided for exchange of information and patent pooling in development of synthetic rubber, was signed in December, 1941, by six companies: Goodyear, Goodrich, Firestone, U. S. Rubber, Standard Oil Development Co., and the Phillips Petroleum Co.

Under arrangement with the RFC, all technical developments and patents in connection with the expanding program of synthetic rubber development were sent to the Government which distributed it among other signatories. The Rubber Act of 1948 directed the President to end the agreement as soon as practicable so that companies could go on with development privately. The agreement was modified informally last April in line with this directive and the latest action ending the agreement on December 28 was the formal cessation.

The pool-ending stipulations, which have now been "formalized," leave in the pool all patents and procedures in joint use up to March 31, 1949. Pool members and the RFC, practically the exclusive manufacturers of GR-S and GR-I, will continue to enjoy use of processes put into the pool before that time.

Decision Lauded by Industry

The decision to put a final end to the patent pool was hailed by several members of the pool. In commenting on the decision, John L. Collyer, president of the B. F. Goodrich Co., stated that he was "naturally gratified" at the decision and predicted that the discontinuance of the agreement "will furnish the incentive needed for discovery and production of better man-made rubbers, a vital objective in the strengthening of national defense."

Harry E. Humphreys, Jr., president of the U. S. Rubber Co., also commended the government's move to end the pool and said that it would act as "a great spur to increased research and development of new synthetic rubbers." Mr. Humphreys added that the one big step for the government to take was "to discontinue the manufacture of synthetic rubbers."

National Moulded Products Corp., of Brooklyn, N. Y., manufacturers of rubber toys, has appointed the Eichorn Exports Corp, of New York City, as its export agent.

AMENDED FEDERAL WAGE-HOUR LAW BECOMES EFFECTIVE JANUARY 25

According to the Wage and Hour and Public Contracts Division of the U. S. Department of Labor, the Fair Labor Standards Amendments of 1949, which affect and make some changes in the Fair Labor Standards Act of 1938, become effective on January 25, 1949. The full significance of what these amendments mean to each employer in the way of changed or increased responsibilities with respect to his employees, is not determinable in all instances at this time. However, employers generally should find some guidance in the following brief summary of the major Wage and Hour Law requirements as amended.

Under the amendments, as formerly, wage and hour coverage under the Fair Labor Standards Act will apply to employees who are engaged in interstate commerce or in the production of goods for interstate commerce. Previously, employees "engaged in the production of goods" included—in addition to employees actually producing goods for interstate commerce—those employees "in any process or occupation necessary to the production thereof." However, under the amended Act the test of coverage for this latter group is whether an employee is engaged in "any closely related process or occupation directly essential to the production thereof."

Minimum Wage Requirement

The minimum wage requirement is increased by the amendments to 75 cents an hour, replacing the former 40-cents-an-hour minimum wage. Each covered employee who is not exempt must be paid at the rate of not less than 75 cents an hour, whether the employee is paid by the hour, by the week, or other basis.

However, while making a minor change with respect to messengers, the amended Act otherwise continues in effect the former provision that subminimum rates may be paid to such employees and to certain learners, apprentices, and handicapped workers, provided a special certificate is issued in accordance with regulations promulgated by the Administrator of the Wage and Hour Division, U. S. Department of Labor.

Under the amendments, the overtime-pay provisions of the Act are revised to make clear what payments to an employee must be included and what payments may be excluded in computing the required time and one-half compensation for hours worked in excess of 40 in the workweek.

Child-Labor Provisions

The amendments broaden the child-labor provisions (which set a mimimum age of 16 for general employment and 18 for hazardous jobs) by directly prohibiting the employment of boys and girls below the minimum age in commerce or in the production of goods for commerce—including any closely related occupation or process directly essential to such production. The amended Act, however, retains the former provision which prohibits the shipment or delivery for shipment in interstate commerce by any producer, manufacturer, or dealer of any goods producted in establishments, in or about which, minors have been employed contrary to the minimum age standards set by the Act, within 30 days prior to removal of the goods. An exception is provided under specified conditions for certain purchasers acting in good faith, in reliance on written statements of compliance.

Under the amendments, as before, a number of specific exemptions are provided from the wage and hour requirements of the Act, although the amendments make some changes in the former exemptions and provide a number of new exemptions. The exemptions are not the same in all instances; some may be complete exemption from both the minimum wage and overtime provisions of the Act, while others are complete—or only partial—exemption from the overtime provisions only. Furthermore, exemptions may be made inapplicable during the workweek by the performance of nonexempt work. And, it should be noted that these exemptions do not apply to the child-labor provisions, from which there are fewer and more restrictive exemptions.

New Test Regulations

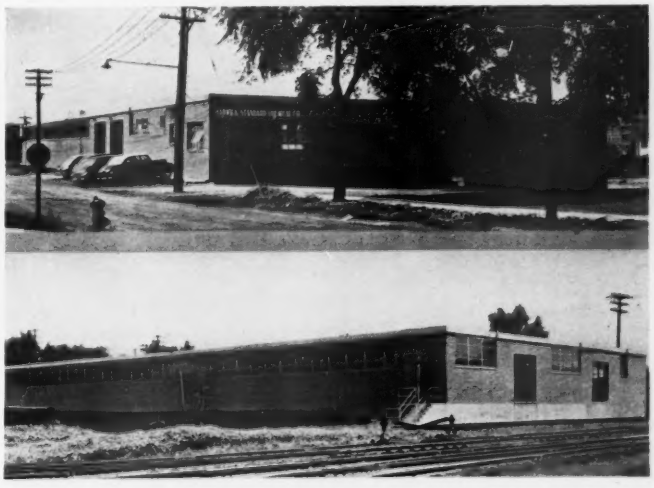
The new regulations contain "tests" of duties, responsibilities, salary levels, and other basic requirements which employers must apply in determining which of their employees may be exempt from the wage and hour provisions of the Wage-Hour Law, such as "executive," "administrative," "professional," "local retailing," or "outside salesman" type of employee. They provide a salary and five tests for "executive" employees; a salary and four other tests for "administrative" and "professional" employees, and two tests each for "local retailing" and "outside salesman" employees, for whom there are no salary tests.

The tests for exemption under the revised regulations include among their basic requirements the provisions that "executive" employees must perform managerial duties; that "administrative" employees must perform office or non-manual field work of substantial importance in the management or operation of the business; that "professional" employees must perform work requiring advanced knowledge in a field of science or learning, or perform creative work in an artistic field; that "local retailing" employees must make local retail sales of "goods or services," or perform work immediately incidental to such sales, and that "outside salesmen" must be engaged to sell, away from their employer's place of business.

The new regulations contain the revised salary levels as proposed on September 10 for the three classifications of "white collar" employees for whom salary tests are among the factors in determining exemption. For "executive" type employees, the new salary test will be $55 a week (or $238.33 a month), to replace the 1940 test of $30 a week. For "administrative" and "professional" type employees, the new salary wil be $75 a week (or $325 a month), instead of the $200 a month test established in 1940.

Also as was proposed, the revised regulations as adopted contain new provisions for determining the exemption status of employees who are paid at least $100 a week on a salary basis. These provisions establish shortened tests for determining whether such employees meet all the specific requirements of the "executive," "administrative," or "professional" definitions.

RECENTLY COMPLETED PLANT OF THE HARWICK STANDARD CHEMICAL CO.



Two views of the new plant and general offices of the Harwick Standard Chemical Co. in Akron, Ohio, are shown above. The plant was opened with appropriate ceremonies on October 22. Two floors provide approximately 50,000 square feet for company operations.

RMA REVIEW INDICATES SATISFACTORY YEAR FOR INDUSTRY IN 1949

Concluding a year which saw high levels of production maintained in virtually all lines of its products, the rubber manufacturing industry faced 1950 with estimates that first quarter output will hold to or exceed present volume and that, barring new unforeseen downturns in the general business picture, this year's performance should at least equal that of 1949. The record of the rubber manufacturing industry's output in 1949 was disclosed in year-end estimates issued by the Rubber Manufacturers Association, Inc. Though off slightly from 1948, both rubber consumption and tire production were high.

The industry consumed an estimated 980,000 long tons of new rubber in 1949, as compared with 1,069,000 tons in 1948. Significant in the consumption picture was the strong position of American-made synthetic rubbers which more than held their own against imported natural rubbers for the year. Synthetic rubber use, at 410,000 long tons, was proportionately higher than it was in 1948.

The proportion of natural rubber consumed, 570,000 long tons, was relatively less than in the year earlier. This was in spite of substantial price advantages. On standard market grade, No. 1 ribbed smoked sheets, the price advantage favoring natural rubber ranged from fractions to as much as two cents a pound. On lower grades which are used in substantial quantity by the industry these differentials ranged to as much as five cents a pound below general purpose synthetic rubber.

Price Advantage of Natural

This price advantage of the natural product was further strengthened by the efforts of the United States government to ease the British and Far Eastern economic crises of 1949 by making substantial reductions in its regulations requiring the use of synthetic rubber in transportation and products. In this move the government cut mandatory use from 223,000 to 162,000 long tons of general purpose synthetic rubber per year, and eliminated all mandatory use of butyl rubber, though retaining standby controls which could be invoked should butyl consumption drop below the level of 15,000 long tons a year. Actually, butyl consumption was more than three times this figure. In general, voluntary consumption of American-made rubbers showed a steady gain throughout the year.

Production of passenger car casings in 1949 reached 65,500,000 units as compared with 66,700,000 units in 1948. Truck and bus tire production was off somewhat more, with 11,050,000 units produced in 1949 as compared with 14,575,000 units in 1948. In the agricultural tire field production and sales held at approximately 1948 levels.

A major gain in the field of automotive products was chalked up, however, by the manufacturers of camelback for the retreading and recapping trade. Camelback sales were 20 percent ahead of 1948. To a large extent, the Association said, this can be accounted for by the growing interest of motorists in having used tires "winterized" with various types of treads designed to meet mud and snow conditions of the winter months.

The heel and sole division of the rubber manufacturing industry likewise showed a gain over 1948. Its shipments of rubber heels and rubber and composition soling and other soling to shoe factories as original equipment on new shoes were slightly ahead of the previous year. In the field of shoe repairing, the takings of heels, soles and soling materials by jobbers just equalled 1948.

Mechanical Rubber Goods

In the field of mechanical rubber goods, the volume trends in the heavier type of business reflected to a marked degree the general business activity of the country as shown by the Federal Reserve Board's Index of Production. Other branches of the mechanical rubber goods business, such as sponge rubber goods, adhesives, friction tape, splicing compound, and rubber thread follow a different pattern. This branch of the rubber manufacturing industry has very definitely resumed its seasonal pattern. Although there has been a steady decline in bookings from the beginning of the year until July, there has been a noticeable upward trend since that time, so that the volume for the year, although below 1948, has been satisfactory insofar as volume of orders is concerned, with the industry looking forward to 1950 with the expectation that business available will approximate the 1949 levels.

Molded and extruded rubber goods, as well as chemically blown sponge rubber products are dependent, to a considerable extent, upon the automotive, refrigerator, washing machine, radio, and other similar industries. During the past year a high rate of volume has been experienced and most manufacturers in this field feel quite optimistic with respect to 1950.

Rubber footwear manufacturers production and sales during 1949 were well above prewar averages, even though the volume was below the record peaks reached during the past three years.

Rubber flooring, which was not permitted to be manufactured during the critical war years, has continued its postwar trend with the volume in 1949 at a higher level than the previous year. Expectations are that the appeal and durability of this type of floor covering will further increase its popularity in the year.

Coated Materials Prospects

The coated materials division of the industry equalled its 1948 volume in the year passed. However, production in the second half was above the same period in 1948 and prospects are that this volume will be maintained at least through the first half of 1950, the Association said.

One of the sensational developments of the year has been the sharp increase in the consumption of natural liquid latex which reached a level of 31,191 long tons in the first ten months of 1949, surpassing the full year's consumption of 1948 when only 28,489 long tons were used. Consumption of synthetic rubber latices also advanced steadily throughout the year. Production here has been siphoned off by the rapidly expanding use of foam rubber in the automotive and upholstery fields.

During 1949 collective bargaining negotiations in the rubber industry were largely centered around welfare plans such as pensions and group insurance. In a few cases agreements were reached regarding these issues, but in most instances the negotiations will carry forward into 1950 before any final settlements will be made. During the early part of the year a few companies entered into agreements calling for wage increases of approximately five cents per hour, but the major portion of the industry did not grant any wage increases this past year.

Sensational new "cold" rubbers, as they are called, claimed their share of the spotlight in 1949 news. Production was increased from thousands to millions of pounds a month, as the Office of Rubber Reserve neared its target in a year-long program for converting its facilities for the production of low temperature polymers. An annual capacity of 200,000 long tons of "cold" rubber had been set as the objective of the conversion program. In heavy demand for its greater wearing quality, particularly for use in tire tread stock, and belting, there is every evidence that 1950 would see new records set in "cold" rubber consumption.

Effect of Devaluation

While the devaluation action of several governments last autumn failed to have any substantial effect on natural rubber consumption, American manufacturers quickly felt the effects of the cheaper currencies in foreign markets for their end products. Hardest hit of American-made rubber products was rubber cut thread which was quickly driven out of the European market. Belting and rubber footwear also suffered and to a lesser degree many other rubber products.

Principal raw material problem of the industry in 1949 related to the quality of natural rubber imports. There was an improvement in ribbed smoked sheets. But in the lower grades, particularly in those used in substantial quantity, quality was generally poor, seldom uniform. Complaints dealt also with poor packing and the frequent absence of grade markings on bales, a breach in direct violation of packing specifications.

Little progress was made by either manufacturers or American rubber dealers in their effort, undertaken when the war ended, to duplicate 1938 standards as represented in R.M.A. type samples which were adopted in that year. As a matter of fact, Malayan shipments through the past year have been so lacking in uniformity that it has proved impossible to draw suitable samples even from individual bales. Despite the generally low quality, rubber imports in 1949 ran somewhat higher than average annual imports for the decade ended in 1939, and thus remained the world's No. 1 commodity earner of dollar exchange for the exporting countries.

The Association said that it is the feeling of the industry that producers of natural rubber could go far in stimulating their sales by improving uniformity of quality, grading according to R.M.A. standards and packing according to specifications.

The year was one of status quo as far as legislation controlling the rubber industry is concerned. The controlling law relating to mandatory use and to operation and disposition of the Government-owned synthetic rubber plants, Public Law 469, does not expire until June 30, 1950.

Much time and attention were given these problems through the year, however, by both the industry and the many government agencies concerned with the security aspects of the problem and the administration of the law. At the year's end all interested parties were waiting the report of the President to the Congress by January 15th. This report will embody the administration's recommendations on the twin issues of mandatory use of synthetic rubber through end-product specification and plant disposal. The questions that will be debated before and by Congress in the session ahead will be whether controls over the industry can be terminated and the plants disposed of after June 30th, whether the plants might then be disposed of with provisions for modifying but further continuing the controls, or whether government-ownership and end product control must continue to some future date.

Other Legislative Matters

Two other legislative matters that are slated for Congressional action in 1950 appeared certain to command much of the industry's attention. One of these is the matter of the discriminatory tire excise taxes which have cost tire users more than a billion dollars since they were levied in 1932. Industry briefs on file with the 81st Congress contend that while tires are not a luxury, they are taxed as such, and that the now excessive wartime rate of tax should be reduced at least to prewar levels.

The other legislative item of major interest to the industry is the proposed Havana Charter for an International Trade Organization. While the industry has not expressed an opinion on the I.T.O., it has devoted much time to study of the proposals since last June when more than 100 leading rubber manufacturers devoted a full day to a forum study of the proposals. As consumer of a commodity that is the world's number one earner of dollar exchange, the industry's interest centers principally in the Commodity Agreements and International Investment sections of the Charter.

Dreyfus Opens Processing Plant

The L. A. Dreyfus Co., of Oak Park, N. J., has opened a new processing plant at Iquitos, Peru. The new plant which is already in production, is processing latex of the *leche caspi* (milk wood) trees in the Amazon jungle. This latex is used as the base for chewing gum. The Dreyfus organization is associated with the William Wrigley Co.

Coming Events

Feb. 3. Akron Rubber Group, Symposium Meeting, Mayflower Hotel, Akron.
Feb. 7 Buffalo Rubber Group, Hotel Westbrook, Buffalo.
Feb. 17. Chicago Rubber Group, Morrison Hotel, Chicago.
Feb. 17. Quebec Rubber & Plastics Group, Annual Ladies Night, Mount Royal Community Hall, Montreal.
Feb. 24. Detroit Rubber & Plastics Group, Detroit-Leland Hotel, Detroit.
Feb. 27-Mar. 3. A.S.T.M. Committee Week and Spring Meeting, Hotel William Penn, Pittsburgh.
Mar. 2. Southern Ohio Rubber Group, Engineers Club, Dayton.
Mar. 13-15. N.A.W.M.D. Annual Convention, Waldorf-Astoria Hotel, New York.
Mar. 17. Boston Rubber Group, Somerset Hotel, Boston.
Mar. 23. Quebec Rubber & Plastics Group, Canadian Legion Hall, Montreal.
Mar. 24. Chicago Rubber Group, Morrison Hotel, Chicago.
Mar. 28-31. Fourth National Plastics Exposition (SPI), Navy Pier, Chicago.
Mar. 31. Akron Rubber Group, Mayflower Hotel, Akron.
Apr. 4. Buffalo Rubber Group, Westbrook Hotel, Buffalo.
Apr. 19-21. Rubber Division, A.C.S., Spring Meeting, Book-Cadillac Hotel, Detroit.
Apr. 20. Quebec Rubber & Plastics Group, Canadian Legion Hall, Montreal.
May 12. Chicago Rubber Group, Morrison Hotel, Chicago.
May 19. Buffalo and Ontario Rubber Groups, Joint International Meeting, General Brock Hotel, Niagara Falls, Ontario.
June 3. Southern Ohio Rubber Group, Annual Outing.
June 16. Akron Rubber Group, Annual Outing.
June 16. Boston Rubber Group, Annual Outing.
June 16. Quebec Rubber & Plastics Group, Annual Golf Tournament.
June 23. Detroit Rubber & Plastics Group, Annual Outing, Forest Lake, Mich.
June 26-30. A.S.T.M., Annual Meeting, Chalfonte-Haddon Hall, Atlantic City.
Sept. 14. Southern Ohio Rubber Group, Engineers Club, Dayton.
Oct. 6. Detroit Rubber & Plastics Group, Detroit-Leland Hotel, Detroit.
Oct. 11-13. Rubber Division, A.C.S., International Rubber Meeting, Hotel Cleveland, Cleveland.
Oct. 20. Boston Rubber Group, Somerset Hotel, Boston.
Dec. 8. Detroit Rubber & Plastics Group, Xmas Party, Detroit-Leland Hotel, Detroit.
Dec. 15. Boston Rubber Group, Xmas Party, Somerset Hotel, Boston.
Dec. 16. Southern Ohio Rubber Group, Xmas Party.

Appointments at General Tire

James Little, for the past seven years controller of the General Tire & Rubber Co., Akron, Ohio, has been named assistant treasurer of the company. At the same time, Huber L. Mollenkopf, who has been associated with General Tire since 1929, was named controller to succeed Mr. Little. The organizational changes also include the appointment of C. A. Hill as assistant controller. Mr. Little is a native of Glasgow, Scotland, and came to this country after his discharge from the British army after World War I. He joined General Tire after more than 20 years with Price, Waterhouse & Co., public accountants. He is a certified public accountant and a member of the American Institute of Accountants. Mr. Mollenkopf was born in Galion, Ohio, and was first employed in the Production Control Department of General Tire. He spent five years in the Cost Department and in 1935 moved to the General Accounting Division. He was auditor of General Tire's ordnance plant in Mississippi until his entry into Army service during World War II. In 1945 he returned to the company as general office manager and more recently as budget administrator. Mr. Mollenkopf is a graduate of the University of Akron and a member of the Akron Chapter of the National Association of Cost Accountants.

Metzner Named Research Director

Dr. Wendell P. Metzner, associated with the Monsanto Chemical Co. since 1936, has been appointed director of research for the Rubber Service Department of the Organic Chemicals Division. Dr. Metzner had been associate director of research for the Rubber Service Department since September, 1947. A native of Bryant, Ind., where he attended grade and high schools, Dr. Metzner obtained an A. B. degree at Indiana University in 1933 and a Ph. D. from the University of Chicago in 1937. He was first employed by Monsanto as a research chemist at the John F. Queeny plant in St. Louis. In 1939, he was promoted to group leader in St. Louis and in 1945 was transferred to the company's Central Research Department at Dayton,, Ohio. At Dayton, Dr. Metzner's work was primarily concerned with the development of new thermoplastic resins and synthetic rubber. He is a member of Phi Beta Kappa, Sigma Xi, Phi Lambda Upsilon, Alpha Chi Sigma, Alpha Tau Omega, and the American Chemical Society.

Original Equipment Price Rise

Original equipment tire prices were raised a minimum of 5% in an industry-wide move initiated by the Goodyear Tire & Rubber Co. on December 28. The increase followed two 3½% price rises on replacement market tires and industry spokesmen have continually hinted that additional increases would be forthcoming. Higher labor and material costs which have not as yet been reflected in prices to manufacturers of new cars and trucks made the rise necessary. Recent increases in freight rates were an added factor.

REPORT ON PLASTICS INDUSTRY RELEASED BY PRESIDENT OF SPI

Horace Gooch, president of the Society of the Plastics Industry, Inc., New York 17, N. Y., and treasurer of Worcester Moulded Plastics Co., Worcester, Mass., has released the Society's annual report on the plastics industry for 1949. According to Mr. Gooch, consumption of plastics products at the turn of the year is continuing its upward swing after reaching a nine-months' low last July. Latest available figures indicate that the current rate of consumption of plastics raw materials is equivalent to or slightly higher than the monthly average a year ago. While the consumption of molded plastic products during 1949 shows a decrease of approximately 10% from the previous year, continuing activity in the vinyl, polyethylene and polystyrene fields particularly, will bring the year's consumption of all plastics products slightly above that of 1948.

Film and Sheeting Field

In the film and sheeting field, vinyl plastics are expanding tremendously. Furniture covers, draperies, tablecloths, place mats, bedspreads, closet accessories, hospital mattress pads, shower curtain, aprons, food bowl cover, etc., continually reach new production heights. Vinyl coverings have expanded tremendously for desk tops, sofas, stools and chairs in the hotel, restaurant, office and home.

In the building and construction field, plastics products will expand further in 1950, the report said. Production of vinyl flooring, for instance, which was large in 1949 will expand further as it becomes standard with more building and construction companies. Plastic builders' blocks made of polystyrene, for interior partitions, have enjoyed a satisfactory growth in their first two years on the market. Their lighter weight, economical installation and variety of colors offer many advantages for building and remodeling.

Other Plastics Materials

Thermosetting plastic materials, which experienced a sharp drop in production in the middle of 1949, are now enjoying a marked increase in sales. Thermoplastic materials had a good year in 1949, said the report, and this activity is carrying into the new year.

The weaving of vinylidene chloride, an extruded monofilament or plastic thread, is continuing to expand. Used particularly for automobile seat covers, public transportation seat coverings, insect window screening and industrial filters, this product is gradually entering new fields formerly monopolized by other materials.

Industrial applications continue to spread, one of the latest developments being in the oil fields where plastics piping, made of cellulose acetate butyrate, is now used. The installation of polystyrene plastic wall tile is increasing throughout the country. Many new homes are installing it in bathroom and kitchen. The use of plastic tablewear is also on the increase. Standards on polystyrene wall tile are about to be issued, and the vinyl film and sheeting division of the plastics industry plans to complete its quality standards through the new year.

Number of Companies

The number of injection and compression molders and extruders of plastics materials currently operating in the United States is estimated at 1,300 companies. Fabricators of sheet, rod and tube approximate 1,500 firms. Fabricators of film and sheeting run into the hundreds and manufacturers of raw materials total approximately 30 companies. Employment in the entire plastics industry is estimated at 100,000 persons.

Retailers, industrialists and industry members will have the opportunity to see the latest products and materials at the National Plastics Exposition being held in Chicago, Ill., on March 28 through 31, 1950. This exposition, sponsored by SPI, is being held at the Navy Pier and will offer the opportunity of studying many different plastics applications to learn how they may be applied in new products or combined, as component parts, with present products.

DuPont University Grants

E. I. du Pont de Nemours & Co., Inc., Wilmington 98, Del., has authorized, for the second year, $100,000 for grants-in-aid to universities to "stockpile" knowledge through the advancement of fundamental science. These grants-in-aid are for unrestricted use in the field of fundamental chemical research. This plan of assistance was inaugurated last year by DuPont on a trial basis with the aim of increasing the amount of such research being done in this country. The grants are for the 1950-51 academic year. They provide $10,000 for each of ten universities, all of which received similar awards from the company for the present school year. The company also provided $20,000 to the University of Chicago for a calendar year 1950 membership in its Institute for the Study of Metals.

MARTIN CHEMICALS DIVISION PURCHASED BY U. S. RUBBER

U. S. Rubber Co. has purchased the Chemicals Division of the Glenn L. Martin Co., for an undisclosed sum. The rubber company has acquired all the assets of the division, including the Marvinol vinyl resin plant at Painesville, Ohio, laboratory equipment in Baltimore, Md., patents and the trade name Marvinol. The business will become a part of the Naugatuck Chemical Division of U. S. Rubber. The Painesville plant will continue to make Marvinol vinyl resin for sale to manufacturers of plastic products.

Through the sale of its Chemicals Division, the Martin company completes its program of concentration in the aviation field, by divesting itself of all interests not directly concerned with the manufacture of airframes, special weapons and closely related products. U. S. Rubber said the purchase is part of a long-range program to expand its activities in the chemical field.

"We are already in plastics and chemicals and have been interested in vinyl plastic for a number of years," said J. P. Coe, vice-president and general manager of the Naugatuck Chemical Division. "The company has carried on a long and intensive research program in preparation for the actual manufacture of vinyl. The opportunity to make such a top quality resin as Marvinol is, therefore, most welcome."

Painesville Plant Data

The plant at Painesville, built in 1947, currently employs about 200 persons, with a monthly payroll of $50,000. Consisting of nine buildings, it is said to be the third largest vinyl plant in the country. It is close to raw material sources and has good rail, highway and water transportation facilities.

The present management at Painesville will continue in charge. Employees on the Martin payroll were transferred to the rubber company's payroll at the end of 1949. The operation includes about 65 employees in Baltimore connected with research and development, sales and technical service. It is planned to transfer Baltimore personnel to the Naugatuck Chemical plant at Naugatuck, Conn., as soon as possible.

Wooster Handimat-Cutting Board

Wooster Rubber Co., Wooster, Ohio, has introduced the Handimat-Cutting Board, a two surface rubber mat and cutting board which may be used on one side as a protector for drain boards, stove tops or utility tables, and on the other side as a cutting board on which fruits, vegetables, breads, etc., may be sliced. The board is 16 x 20 inches in size and has a food measuring table stamped on one end as an added convenience. The heavy, tough ribbed protective mat is heat resistant and serves as a minimizer of dish and glassware breakage. The surface is said to get its hardness and toughness from addition of the reinforcing agent Good-rite Resin 50, a product of the B. F. Goodrich Chemical Co., Cleveland 15, Ohio.

LONGEST SINGLE CONVEYOR BELT CONSTRUCTED BY GOODYEAR CO.

The world's longest single conveyor belt, for use in transporting coal at the Weirton Mine of the Weirton Steel Co., near Morgantown, W. Va., has just been installed by the Mechanical Goods Division of the Goodyear Tire & Rubber Co., Akron, Ohio. The Compass-150-Steel Cord belt will haul coal from the washery located near the mine through a tunnel in an adjacent hill to a tipple on the Monongahela River for loading into barges.

Measuring 10,900 feet from the center of the head to center of the tail pulley, installation of the endless rubber, steel and cotton belt established a new record for length for any type belt. The former record was set by Goodyear on the Grand Coulee Dam project 10 years ago. That belt was 4,985 feet long, measured on horizontal centers.

Goodyear furnished more than 22,000 feet of belting for the haul through the tunnel and return. Weighing approximately 122 tons, the construction of the new "super rubber railroad" consumed 152,798 pounds of rubber, 50,941 pounds of cotton and 39,754 pounds of steel cable. The belt is 30 inches wide and will be required to deliver approximately 250 tons of coal per hour while conveying at a speed of 300 feet per minute, and will be driven by a 200 h.p. motor. A lump of coal dropped on the belt at the washery end will dump into a waiting barge on the Monongahela River 36 minutes later.

The conveyor has a vertical drop of approximately 135 feet in the 10,900 feet distance from washery to the tunnel mouth at the river. It was decided to make the installation as one single belt to eliminate the hazards and added operating costs of transfer points.

Because of the unique layout of this belt it was essential that any stretch or shrink be reduced to the absolute minimum, as it was impossible to provide space for any takeup arrangement that would accommodate more than 40 feet of belt. The takeup required will not be more than 25 feet despite the 22,000 foot length of the belt, Goodyear stated.

New Use for Rubber Tile

The Amerbel Corp. of Brussels, Belgium, is considering the use of rubber tiling for an indoor tennis court, according to the Wright Manufacturing Co., Houston 5, Texas. Officials of the Wright organization explained that the company had never made an installation of this sort. However, on the basis of past experience in flooring for basketball courts, it was felt that rubber tiling could be recommended for indoor tennis courts. Rubber tile's hard surface and non-slip qualities as well as its ease of maintenance suit it to tennis court flooring. Inserts of rubber tile used for everything from defining foul and court lines of basketball gymnasiums to outlining the players' benches in school colors could be used similarly for indoor tennis courts, Wright officials said.

Acquires Eneu Johnson Stock

Directors of the United Carbon Co. on December 29 approved the acquisition by the company of the entire capital stock of the Charles Eneu Johnson Co., Inc., of Philadelphia, Penna., manufacturers of carbon black and printing ink. The Johnson company was established in 1904. The business of the Johnson concern is expected to remain under its present management.

Jeter Named Goodrich Secretary

Raphael G. Jeter has been elected secretary and general counsel of the B. F. Goodrich Co., Akron, Ohio, succeeding Willis F. Avery, who retired on December 31 after more than 25 years service with the company. Mr. Jeter joined Goodrich in 1948 as general counsel. He is a native of Arkansas, but has lived in Akron since childhood, attending Akron schools and the University of Akron. The new secretary was graduated from Ohio State University in 1932 with the degree of bachelor of laws and was admitted to the practice of law the same year. He was formerly counsel for the Ohio Edison Co. and the Akron Transportation Co. He is a member of the Akron and American Bar Associations. Mr. Avery joined Goodrich in 1924 after five years in the U. S. Patent Office and four years on the legal staff of the Westinghouse Electric Co. He was named assistant secretary in 1936 and elected secretary in 1944. He is a native of New Hampshire and was educated at Brown University, the University of Maine and the Washington, D. C., College of Law.

Discontinue Lockwood Report

Lockwood's Monthly Rubber Report, issued by W. S. Lockwood, Inc., Washington, D. C., has suspended publication effective with the December, 1949, issue. Although suspension came at a time when the monthly report was at its subscription peak, it was based on the fact that the publishers are now associated with the recently-organized Natural Rubber Bureau and they felt that they could not continue to write a completely impartial and unbiased report. Mr. Lockwood is director of the Natural Rubber Bureau, which was organized by rubber producing interests in Southeast Asia with the primary intent of expanding current applications of natural rubber. Lockwood's Monthly Rubber Report was first issued in January, 1947.

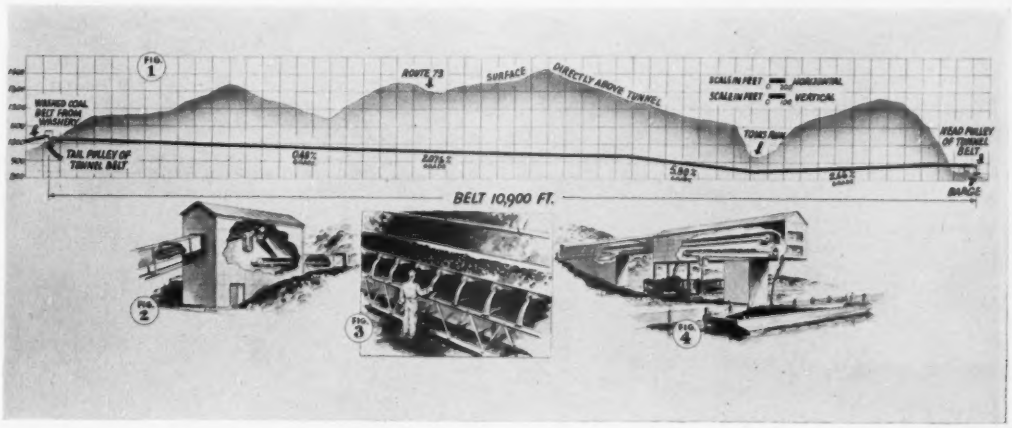


FIGURE 1—An artist's conception of the profile of the world's largest single unit conveyor belt, recently installed at the Weirton Mine of the Weirton Steel Co., Morgantown, W. Va., by the Mechanical Goods Division of the Goodyear Tire & Rubber Co. The illustration depicts the manner in which coal is carried through a two mile tunnel from transfer house to a loading point on the Monongahela River. FIGURE 2—The transfer house and the tail end of the belt can be seen in this sketch. Coal from the washery arrives at the transfer point on the short belt, dumps on the main belt for the journey through the tunnel. FIGURE 3—Here the 30-inch belt conveys coal through the tunnel. FIGURE 4—The general layout of the river tipple and head end of the belt are shown.

Oakleaf Heads Cleveland Committee

Amos W. Oakleaf, sales manager of the Philblack Division of the Phillips Chemical Co., with headquarters in Akron, has been general chairman of the 1950 Fall Meeting of the Division of Rubber Chemistry. The Fall Meeting, which will be held at the Hotel Cleveland, in Cleveland, Ohio, on October 11-13, 1950, will be an International Rubber Meeting. Mr. Oakleaf has already appointed chairmen for various activities as follows: *Registration,* E. H. Krismann (DuPont); *Program,* William Von Fischer (Case Institute of Technology); *Publicity,* Ralph F. Wolf (Columbia Chemical); *Banquet,* Ferd A. Bonstedt (Richardson Carbon); *Finance,* Henry F. Palmer; *Housing,* C. A. Smith (N. J. Zinc); *Advisory,* C. W. Christensen (Monsanto Chemical). Mr. Smith, in addition to heading the Housing Committee, will also function as vice-chairman of the arrangements committee. The divisional banquet will be held on Thursday evening, October 12, at the Hotel Carter. It will be preceded by a Suppliers Cocktail Party which is under the chairmanship of A. I. Brandt (Goodrich Chemical).

NBS Standard Sulfur Compounds

The National Bureau of Standards has made available high-purity standard samples of organic sulfur compounds to interested laboratories of the petroleum, chemical and allied industries. These compounds are prepared, under the sponsorship of the American Petroleum Institute, by the Bureau of Mines of the U. S. Department of the Interior, where they are used for the measurement of needed physical, thermodynamic, and spectral properties. A portion of each compound is set aside to provide standard samples for calibration of analytical instruments and apparatus in research, development, and analytical laboratories. A total of eight sulfur compounds are now available as standard samples. Instructions for ordering may be obtained from the National Bureau of Standards, Washington 25, D. C.

Science of Odor Reduction

The Chemical Division of 44 Trinity Place Corp., 44 Trinity Place, New York 6, N. Y., is said to have developed a new approach to the problem of overcoming objectionable odors in industrial products. Research in the "science of odor reduction" has discovered certain basic principles and scientific techniques which can be followed to develop a suitable formulation for each specific type of industrial product with an objectionable odor, the company states. To this end, the Chemical Division of the company has developed a line of materials designed to meet the different needs of odor reduction. Formulations have been developed which are effective for odor reduction of tall oil, fish liver fatty acids, petroleum products, naphthenic acid, kettle bodied linseed oil, stearic acid, red oil, and many other chemicals and products.

The 1949 RUBBER RED BOOK answers your daily questions.

U. S. Rubber Advances Kieswetter

H. G. Kieswetter

Herbert G. Kieswetter, formerly vice-president and assistant general manager of the United States Rubber Export Co., Ltd., has been appointed assistant general manager of the mechanical goods division of the United States Rubber Co., the parent company. Born in Astoria, N. Y., and educated in New York schools, Mr. Kieswetter joined the export company in 1925 as a salesman, and represented the company in many parts of the world, including Latin America. He was appointed assistant general manager in 1942 and named to his last position in 1945.

Changes at General Cable

Several changes were recently made in the manufacturing personnel of the General Cable Corporation. Al Hagan, formerly plant manager at Los Angeles has been transferred to the Perth Amboy plant in the same capacity. He has been succeeded at Los Angeles by Irving Koth. Joe Waters, formerly technical assistant to the plant manager at Perth Amboy, has been named assistant plant manager, while George Dover, who had been acting plant manager is now production superintendent. F. Y. Kreimendahl, formerly with the Perth Amboy plant, has been named plant manager at the Rome plant, succeeding John T. Dugall who has left the organization to join the Kaiser Aluminum & Chemical Co. at Newark, Ohio. W. A. Vincent remains as plant manager at St. Louis and G. W. Cassell as plant manager at Emeryville.

Wheelco Licenses French Firm

Wheelco Instruments Co., Chicago 7, Ill., manufacturers of recording and control instruments, have recently signed a licensing agreement with a French instrument manufacturer. The Wheelco Capacitrol, an electronic controller, will be manufactured by La Pyrometrie Industrielle, Paris, France, and the Flame-otrol, a combustion safeguard, will be manufactured by their subsidiary, Le Controle de Chauffe de Bagneux, France. The terms of the license permits the distribution of these two Wheelco instruments in France, Spain and Portugal.

Todd to Manufacture Karge Unit

Under recently completed arrangements, the Todd Co. of Rochester, N. Y., will manufacture and distribute the Karge Turnomat, a precision lathe and screw machine attachment for automatic turning to extremely close tolerances. Patent rights to the Turnomat were acquired from Karge & Son Machine Co.,, Brockport, N. Y. The Turnomat, as developed by Karge, is designed especially for extremely slender turning of either shafts or tubing. The unit can be used for turning rubber, plastics or fiber, as well as metals. In addition to turning, it will center to extreme accuracy, drill ream, tap, thread, thread chase and taper. Todd is planning a full-scale development program for the Turnomat, and a distribution organization of manufacturers' agents and dealers is to be built. The unit will be supplied in six different models to provide a wide range of sizes. Four models are designed especially for turning and two models for taper turning.

Petroleum Refining Patents

The Technical Information Division of the State Engineering Experiment Station of the Georgia Institute of Technology, Atlanta, Ga., has announced plans for the preparation of a bi-weekly "Digest of Petroleum Refining Patents" and for additional related services such as the preparation of abstract cards. This bi-weekly "Digest" will serve to keep petroleum chemists and engineers abreast of the most recent developments in their fields. Patent abstracts will be in the hands of subscribers within two or three weeks of their issuance. Patents located will be classified under pertinent processes, materials or other subjects, such as equipment, petroleum substitutes, synthesis, etc. By-products, specialties, and petroleum chemicals will be covered. Under the proposed program, costs will be shared proportionately by participating companies, each of whom will designate the number of copies of the bulletin that it desires.

Article on Clay Mining

The November-December, 1949 issue of *Huber News,* house organ of the J. M. Huber Corp., New York 17, N. Y., contains an interesting article on open pit mining of kaolin clay. The article, entitled "Sidewalk Superintendent's Paradise," describes open pit mining as it is practiced by the Clay Division of the Huber organization. Techniques and processes are outlined. Another section of the house organ is devoted to a description of the book "Industrial Clays and Their Industrial Uses," which has been published by Huber. This book was reviewed in a recent edition of RUBBER AGE.

Diamond Alkali recently announced a 15% price reduction on Chlorowax 70, its resinous chlorinated paraffin which adds flame resistance, adhesion, gloss, water resistance and chemical resistance to many products. The new carload price is 15c a pound.

Hot Tips on Cold Rubber:

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NAMES IN THE NEWS

SIDNEY C. MOODY, vice-president of the American Cyanamid Co., has been elected president of the Synthetic Organic Chemical Manufacturers Association.

ELMORE J. BARUTH, formerly associated with the Richardson Co., Indianapolis, Ind., has joined the technical staff of the Brown Rubber Co., Lafayette, Ind.

J. E. MATHIE, associated with the U. S. Rubber Co. since 1927, has been appointed manager of the Government Department of the company succeeding CARL A. TANNER, who has retired after 22 years of service.

BARCLAY K. READ, formerly associated with Western Division headquarters of the Shell Chemical Corp., has been appointed assistant sales manager of the Eastern Division of the corporation.

JAMES W. HARLEY, director of traffic for the U. S. Rubber Co., has been elected president of the Traffic Club of New York.

HUGO PULVER, executive vice-president of H. Kohnstamm & Co., Inc., New York, N. Y., was honored at a recent testimonial dinner celebrating his fiftieth anniversary with the company.

JOHN L. COLLYER, president of the B. F. Goodrich Co., has been decorated with the French Legion of Honor for services rendered to the allied cause during the war and to French industry during reconversion.

DANIEL M. MAGEE, formerly associated with the Plastics Division of the Celanese Corp. of America, has been appointed selling agent for Velon yarn by the Firestone Plastics Co., Pottstown, Penna.

GEORGE LAMSON, associated with the Thermoid Co., Trenton, N. J., since 1936, has been appointed manager of the Automotive Replacement Sales Division of the company.

MORRIS S. ROSENTHAL, president of Stein, Hall & Co., New York, N. Y., has been named chairman of the Exports and Imports Division of the 1950 New York Heart Campaign.

LAURENCE F. WHITTEMORE, actively associated with the Brown Co., New York, N. Y., since 1935, and former president of the New Haven Railroad, has been elected president of the Brown Co. and the Brown Corp., succeeding F. G. COBURN, who recently resigned.

W. T. L. TEN BROECK, formerly associated with the research department of the Goodyear Tire & Rubber Co. at Akron, has been transferred to the staff of the Goodyear Rubber Plantations Co. He is stationed at Rengam, Johore, Federation of Malaya.

DR. WILBUR H. MILLER, associated with the staff of the Stamford Research Laboratories of the American Cyanamid Co. since 1941, has been appointed technical representative and assistant manager of the company's Washington, D. C., office.

DR. J. H. DILLON, director of research at the Textile Foundation and the Textile Research Institute, Princeton, N. J., and visiting lecturer in chemistry at Princeton University, was recently elected a fellow of the Textile Institute, Manchester, England.

DONALD W. HOOVER, associated with the Rubber Corporation of America, Brooklyn, N. Y., for many years, most recently as a vice-president, has left that organization.

MILTON W. HAYES, manager of the production control department of the Brown Co. at Berlin, N. H., since 1948, has been named assistant to the works manager. He will be responsible for the Bermico, Onco, Chemical and Floc Manufacturing Divisions.

BRUCE S. WILLIAMS, formerly manager of the southeast territory, belting division, Russell Manufacturing Co., has been appointed assistant to the president of the company. He will make his headquarters at Middletown, Conn.

WILLIAM H. LEHMBERG, associated with the American Felt Co., Glenville, Conn., since 1943, has been elected a vice-president of the company.

DAVID DOUGLAS HALDANE, until recently distributing agent and deputy director of the Office of Rubber Reserve, has joined Littlejohn & Co, Inc., New York, as a vice-president.

JAMES C. ZEDER, chairman of the engineering board of the Chrysler Corporation, Detroit, has been elected president of the Society of Automotive Engineers for 1950.

ROBERT T. PRING, until recently director of the industrial hygiene department of the Kennecott Copper Corp., has been named technical director of the dust and fume division of the American Wheelabrator & Equipment Corp, Mishawaka, Ind.

HARVEY S. FIRESTONE, JR., board chairman of the Firestone Tire & Rubber Co., has been elected chairman of the 25-member Ohio Sesqui-Centennial Commission planning Ohio's 150th birthday celebration in 1953.

ALBERT J. COLE, until recently associated with the plastics division of the Firestone Tire & Rubber Co., has joined the Pottstown Manufacturing Co., Pottstown, Penna., as chief chemist.

Cox Leaves Rubber Reserve

Dr. John T. Cox, Jr.

Dr. John T. Cox, Jr., has resigned his position as Deputy Director of the Office of Rubber Reserve and has begun the practice of consulting chemical engineering in association with Russell S. and Gordon W. McBride at 1518 K St., N.W., Washington 5, D. C. Dr. Cox was in charge of synthetic rubber production and for some time will maintain a consulting and advisory relationship to Rubber Reserve. A native of Louisiana, Dr. Cox received his chemical engineering education at Louisiana State University and M.I.T., and was awarded a Doctor of Engineering degree by the Case Institute of Technology for his work on synthetic rubber. Prior to joining Rubber Reserve, Dr. Cox was associated with the Firestone Tire & Rubber Co. A founder and past president of the Chemical Engineers Club of Washington, Dr. Cox is also a member of the American Chemical Society and the American Institute of Chemical Engineers. He is a board member of the District Council of Engineering Societies.

DR. HERMAN F. MARK, director of the division of polymer research at the Polytechnic Institute of Brooklyn, left for India on December 27th where he will lecture at several Indian universities. He is a fellow of the Indian Academy of Sciences.

H. D. DAWSON, formerly assistant manager of the Delco-Remy Division of the General Motors Corp., Anderson, Ind., has been appointed general manager of the division, succeeding O. V. BADGLEY, who has retired under the company's retirement plan.

DR. W. ALBERT NOYES, JR., professor of physical chemistry at the University of Rochester, has been named editor of the *Journal of the American Chemical Society*, succeeding DR. ARTHUR B. LAMB of Harvard who has retired.

THOMAS R. RUDEL, associated with the Eberhard Faber Pencil Co. since 1932, has been elected president of the company.

SUTTON AND EDWARDS HEAD THE BOSTON RUBBER GROUP

Approximately 415 members and guests attended the annual Christmas Party of the Boston Rubber Group, held on December 16 at the Somerset Hotel in Boston, Mass. The meeting featured the election of officers, dinner, a program of entertainment, and distribution of a limited number of door prizes purchased with group funds.

Officers elected to serve for the 1950 season included the following: *Chairman,* Harry W. Sutton (Boston Woven Hose); *Vice-Chairman,* Thomas Edwards (Acushnet Process); *Secretary-Treasurer,* John Andrews (Cabot). Alan Bryant (Binney & Smith) and P. A. Uva (Avon Sole) were elected members of the Executive Committee.

The Nominating Committee was headed by James R. Geenty (Goodall-Sanford) as chairman, and included Richard K. Patrick (Vulplex) and Charles E. Reynolds (Odell).

Kem-Ban Protective Coating

Ace Laboratories, Lakewood, Ohio, have developed "Kem-Ban," a new multi-purpose protective paint specifically designed to meet the demands of coating and production finishing applications in the rubber, textile, chemical processing and other industries. Based on a specially selected copolymer as the binder, and incorporating certain key rubber derivatives as plasticizers, the formulation is said to provide, for the first time in a single material, both effective rust-inhibiting action and excellent resistance to acids, alkalies, chemical fumes, moistures, salts and alcohols. Applied by spray, dip or brush methods, Kem-Ban dries in from 20 to 30 minutes. Depending upon the film thickness desired, the material can be reduced for application from 20 to 50% with ordinary turpentines.

Ohio College Honors Seiberling

A new gymnasium to be constructed at Heidelberg College, Tiffin, Ohio, will be named in honor of Frank A. Seiberling, chairman of the board of the Seiberling Rubber Co., Akron, Ohio. Mr. Seiberling, who attended Heidelberg in 1876 and 1877, gave $75,000 in securities to the college 24 years ago. He is a member of the school's board of trustees. The new gymnasium will be known as the Seiberling Health and Physical Education Building. The site provides space for a new football field, stadium, track, tennis courts, baseball diamond and large parking area.

Nationalize Hungarian Plant

A sweeping nationalization decree affecting all trade and industry in Hungary which was still in private hands or financed by foreign capital was issued in Budapest on December 29. Among the companies affected by the decree was the Hungarian Rubber Goods Co., which was largely British owned. The official explanation of the decree was that the step enabled the government to take possession of all major industry to control and direct it within the framework of its planned economy.

Named Executive Vice-President

G. G. Beard

The United Engineering and Foundry Co. of Pittsburgh, Penna., has announced the election of G. G. Beard as executive vice-president of the company. Mr. Beard began his service with United as an engineer in 1927. He became manager of the Proposal Department in 1935 and was placed in charge of sales engineering in 1943. In the latter year he was elected a vice-president and in 1944 became a director of the company. Mr. Beard is also president of the Lobdell United Co. of Wilmington, Del., and of Stedman's Foundry and Machine Works, Inc., of Aurora, Indiana. These companies are wholly-owned subsidiaries of United Engineering.

Safety Officers Elected

Newly-elected officers of the Rubber Section of the National Safety Council, named at the recent annual meeting in Chicago, include the following: *General Chairman,* H. L. Andrews (Firestone, Akron); *Vice-Chairman,* S. A. Wright (Inland Mfg. Div., General Motors, Dayton); *Secretary,* George Burkhardt (General Tire, Akron). R. M. Boyles (Midwest Rubber Reclaiming) is the new editor of the Section's Newsletter. The following committee chairmen have been appointed: *Engineering,* T. J. Cain, Jr. (Goodrich); *Trade Association,* M. E. Badstuber (Ohio Rubber); *Health,* F. W. Sands (U. S. Rubber); *Membership,* C. E. Beck (St. Clair Rubber); *Poster,* L. F. Nixon (Canadian Synthetic Rubber); *Statistics,* J. J. Raytkwich (Naugatuck Chemical).

Offer Carbon 14 Standards

The increasingly widespread use of Carbon 14, the radioactive isotope of carbon, brought a critical need for uniform measurement standards. In recognition of this need, the National Bureau of Standards at Washington, D. C., has prepared a series of standard ampoules of a sodium carbonate solution containing definite, known amounts of Carbon 14. These ampoules will serve as comparison standards for the calibration of measuring instruments used in actual radioactive tracer work with the material. Further details may be secured from the Bureau.

AUGENSTEIN ELECTED CHAIRMAN AT BUFFALO CHRISTMAS PARTY

Approximately 130 members and guests attended the annual Christmas Party of the Buffalo Rubber Group held on December 13 at the Hotel Westbrook in Buffalo, New York. The meeting featured an election of officers. A dinner was served and entertainment provided. Souvenirs were distributed to the members and their guests as mementos of the occasion.

Members elected to office for the 1950 season of the group included: *Chairman,* John Augenstein (U. S. Rubber Reclaiming); *Vice-Chairman,* Paul Tufts; *Secretary-Treasurer,* Oren A. Ferster. Members elected to serve on the Executive Committee for 1950, in addition to three officers, included: B. Wetherbee (Wetherbee Chemical), R. E. Schutz (U. S. Rubber Reclaiming), P. J. Sick, Walter Lex, Fred Kohlhagen (Globe Woven Belting), and Charles Miserentino (Dunlop Tire).

Metallic Finish Upholstery Material

U. S. Rubber Co., New York 20, N. Y., has announced a new type of metallic finish upholstery material for baby carriages which is said to be highly resistant to aging, weathering and sun exposure. The company produces the new material, called Naugalite, by adding a metallic pigment to the synthetic resin finish manufactured at its Mishawaka, Ind., plant. The pigments are ground into the mixture and applied to the surface in a double coating operation made possible by special equipment developed by the company. In addition to its metallic finish, the material has a high luster and sheen. It is tough, yet soft and flexible. Naugalite is waterproof and may be cleaned with soap and water. The product is said to be scuff-proof and highly resistant to scratching, tearing and stains.

Issue OTS Report on Corrosion

The Office of Technical Services of the Department of Commerce, Washington 25, D. C., has made available a study on corrosion prevention of steel and rubber assemblies. According to the report, a 10% barium ricinoleate in castor oil was found to be an excellent corrosion preventive for steel in conditions of high humidity, and was not considered dangerous to the various types of rubber tested. Accordingly, U. S. Air Force researchers recommended it as a protective coating on steel and rubber assemblies. Copies of the report, PB 98777, *Prevention of Deterioration,* may be secured from OTS for $2.00 in microfilm and for $3.75 in photostat.

Producing Rubber-Latex Molds

Vertrod Corporation, 17 Williams Ave., Brooklyn 17, N. Y., manufacturers of electronic sealing devices, is now producing electroformed molds and forms for all types of products used in the rubber and latex industry, including seamless one-piece molds. Molds for doll parts is a specialty of the company.

ELECTION OF OFFICERS FEATURES DETROIT GROUP CHRISTMAS PARTY

An election of officers featured the annual Christmas party of the Detroit Rubber Group held on December 9 at the Detroit-Leland Hotel, Detroit, Mich. The meeting also featured a program of entertainment and the serving of a gala dinner. A short business session preceded the entertainment.

Members elected as officers for the 1950 season of the group included: *Chairman,* G. M. Wolf (Sharples Chemicals); *Vice-Chairman,* G. T. Lindner (Minnesota Mining); *Treasurer,* E. J. Kvet (Baldwin Rubber); *Assistant Treasurer,* J. C. Dudley (Chrysler); *Secretary,* E. V. Hindle (U. S. Rubber); *Assistant Secretary,* W. Bauer (Brown Rubber). W. B. Davies (Kaiser-Frazer) and J. P. Wilson (Ford) were elected to serve as counselors for the group.

Other members elected to serve on various committees include: *Program,* G. R. Cutherbertson (U. S. Rubber), chairman; and W. J. Simpson (Chrysler), vice-chairman; *Entertainment,* T. W. Halloran (Chemical Products), chairman; and H. W. Neale (Pioneer Latex), vice-chairman; *Publicity,* G. P. Hollingsworth (Minnesota Mining), chairman; and J. T. O'Reilly (Ford), vice-chairman.

The next meeting of the group will be held at the Detroit-Leland Hotel on February 24. James D'Ianni, of the Goodyear Tire & Rubber Co., will deliver an address on "Butadiene-Styrene Polymers."

Ontario Group Hears Tapp

The December 8 meeting of the Ontario Rubber Group was held in conjunction with the Wellington-Waterloo Section of the Chemical Institute of Canada in Kitchener, Ont., Canada. Approximately 110 members of both groups attended the meeting which was addressed by Dr. J. S. Tapp of the Polymer Corp., Sarnia. Dr. Tapp discussed in detail the manufacture of synthetic rubber and the steps taken to eliminate cross range polymers and the production of the majority of straight line polymers. He also pointed out further relationships between chemical structure and increased physical characteristics of finished stocks. The January meeting of the group was scheduled to be held at the University of Toronto on January 10. The meeting was to have been addressed by M. O. Orr of the B. F. Goodrich Co., Akron, Ohio.

Southern Ohio Christmas Party

The Southern Ohio Rubber Group held its annual Christmas party on December 10, at the Miami Valley Golf Club, Dayton, Ohio. The meeting featured a program of entertainment, dinner and the distribution of door prizes. Each lady present received a LaCrosse cuticle set. The next meeting of the group is scheduled for March 2 at the Engineer's Club in Dayton, at which time William A. Wiard of the Dow Corning Corp., Midland, Mich., will present his paper on "Silastic, Its Properties and Place Among Synthetic Rubbers."

D. E. Jones

Newly-elected chairman of the New York Rubber Group.

ANNUAL ELECTION FEATURES NO. CALIFORNIA XMAS PARTY

The annual Christmas Party of the Northern California Rubber Group was held on December 12 at the Willows in Orinda, Calif. Approximately 110 members and guests attended the meeting which featured the installation of officers for the 1950 season of the group. Dinner was served and entertainment provided by three members of the San Francisco Ex-Major League Ball Players Club.

The following members will serve as officers of the group for the 1950 season: *Chairman,* Fred V. Swain (Pioneer Rubber); *Vice-Chairman,* Robert R. James (Mare Island Naval Shipyard); *Secretary,* John F. Mason (Pioneer Rubber); *Treasurer,* Grover S. Ramsey (Grove Regulator).

The following group members were installed as directors for the 1950 season: Joseph W. Hollister (Mare Island Naval Shipyard), E. P. Coxhead (Goodyear), and R. J. Henderson (American Rubber Mfg.).

Chicago Group Holds Xmas Party

Approximately 650 members and guests of the Chicago Rubber Group attended the annual Christmas party held on December 16 at the Morrison Hotel in Chicago, Ill. Dancing and entertainment followed the serving of a banquet dinner. All ladies present received gold compacts as party favors. The party committee was headed by John C. Gallagher (Allis Rubber).

A 16-page booklet outlining its numerous products has been issued by the General Aniline & Film Corporation under the title "All These and More" Among products mentioned are dyestuffs, film, cameras, detergents, textile specialties, and Ozalid. Research facilities are also outlined.

NEW YORK GROUP XMAS PARTY FEATURES OFFICER ELECTION

The annual Christmas party of the New York Rubber Group was held on December 16 in the Grand Ballroom of the Henry Hudson Hotel, New York 19, N. Y. The meeting featured an election of officers for the 1950 season. A cocktail session preceded the serving of a dinner which was followed by a period of entertainment and the distribution of door prizes.

Officers elected to serve during 1950 included: *Chairman,* D. E. Jones (American Hard Rubber); *Vice-Chairman,* Howard Ling (Naugatuck Chemical); *Secretary-Treasurer,* Peter P. Pinto (RUBBER AGE). T. F. Callahan (Witco) was elected sergeant-at-arms. The following members were elected to serve on the Executive Committee for a 3-year term: Sherman R. Doner (Manhattan Rubber), William Lamela (Okonite), R. H. Cubberly (Flintkote), and William S. Rea (United Carbon).

The following members served on the Nominating Committee: M. R. Buffington (Lea Fabrics), chairman, and Harry Outcault (N. J. Zinc), Joseph E. Waters (General Cable), and Frank Malm (Bell Telephone).

Plans Symposium on Machinery

A discussion of new developments in rubber processing machinery will make up the program at the Third Annual Midwinter Symposium to be held by the Akron Rubber Group at the Hotel Mayflower, Akron, Ohio, on February 3. The two principal speakers at the symposium will be Donald A. Comes, assistant general sales manager of the Farrel-Birmingham Co., Inc., Ansonia, Conn., and Allen L. Heston, vice-president of the National Rubber Machinery Co., Akron. Mr. Comes will discuss new developments in mixing equipment, while Mr. Heston will cover the subject of extruders. In addition, a panel of experts has been assembled to discuss these subjects and to answer questions about rubber processing problems. The panel will include George L. Bruggemeier (Firestone), Paul Beebe (Goodyear), A. W. Phillips (General Tire), and Robert H. Wattleworth (Goodrich). A dinner and an evening program featuring an outstanding national figure in the world of sports will follow the technical session.

Moves Industrial Oil Offices

The administrative offices of the Industrial Oil Division of Swift & Co. are being moved from Chicago, Ill., to Hammond, Ind., in a move to integrate the division's business. The move is scheduled for completion on or about January 1, 1950. Included in the transfer will be the executive personnel, raw material buying, sales representatives, clerical staff, etc. Swift recently constructed a modern, integrated fractionation and decolorizing plant at Hammond as part of a proposed technical products group. The new office address will be Swift & Co., Technical Products Plant, 165th Street and Indianapolis Boulevard, Hammond, Ind.

Initial Plates for Rubber Shoes

A new identification device for rubber footwear has been devised by the Rub-R-Nam Manufacturing Co., 711 East Lake St., Minneapolis 8, Minn. More than 700 individual metal initial plates made of lightweight brass, nickel plated, are provided in

a special kit together with a specially designed tool for applying them to rubber footwear. A retailer affixes the initial plates, called Name-Ies, to the footwear at the point of sale by the use of the special tool, the Press-O-Name. In this way, the purchaser of a pair of rubber shoes or overshoes can have his purchase permanently identified with his initials. This system should prove a boon to mothers whose children misplace or lose rubbers or overshoes.

Plasti-Cell Polyvinyl Chloride

Plasti-Cell, a new material of expanded unicellular polyvinyl chloride, has been announced by the Sponge Rubber Products Co. of Shelton, Conn. The company emphasizes that this expanded plastic does not replace natural cellular rubber, but merely enlarges the company's product applications. In addition to the properties attributed to polyvinyl chloride, the company's process yields a product of light weight, ranging from 2 to 12 pounds per cubic foot. The compression range of Plasti-Cell runs from 1½ pounds per square inch to 150 pounds per square inch. Insulation value is illustrated by a K factor of .20 or less, depending upon density. Excellent electrical properties are claimed. The material is non-toxic, odorless and imparts no taste. The first finished product made of the new material is the 'n icer bucket, an ice cube container of great insulating efficiency. This bucket was described in the December, 1949, issue of RUBBER AGE.

Testing Companies Merge

United States Testing Co., Hoboken, N. J., and the Esselen Research Corp. of Boston, Mass., have been merged as of January 1, 1950. As of that date, the Esselen Research Corp. became the Esselen Research Division of the United States Testing Co., and will continue its operations in Boston under the direction of Dr. Gustavus J. Esselen, its founder. This merger makes available to industry a unique combination of research personnel, facilities and experience, and it multiplies the scope and potentials of both organizations in basic and applied research for industry and government.

Bakelite Enjoys Record Year

Steadily increasing production and sales of plastics materials during 1949 established record figures for the 39-year history of the Bakelite Corp., New York 17, N. Y., unit of Union Carbide and Carbon Corp. Officials of the Thermoplastics and Thermosetting Departments state the scheduled expansion program for 1949 has been completed and that most of the production facilities for Bakelite and Vinylite plastics are now operating at full capacity at plants about the country. Production of phenol is scheduled for the end of 1950 at a new plant under construction near Marietta, Ohio.

Greatest increase in the sales and production of the various plastics is shown in the rapidly expanding volume of vinyl plastics film. The industry's current monthly output is approximately 40,000,000 to 50,000,000 square yards as compared with the industry's monthly production of 5,000 to 10,000 square yards 10 years ago. Styrene molding plastic production, according to Bakelite officials, is also expected to continue at a high level. During September, 1949, the industry set an all-time sales record of 19,700,000 pounds of styrene.

Firestone Farm Tractor Tire

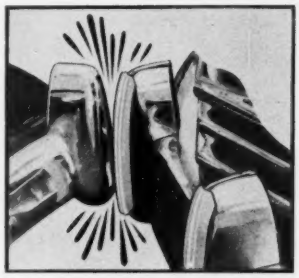
A new farm tractor tire, featuring a curved bar, open-center tread design, has been introduced by the Firestone Tire & Rubber Co., Akron, Ohio. Its advanced scientific design and construction is said to provide better traction, improved self-cleaning, longer service and a smoother ride for this type of tire. With its companion tire, the patented Traction Center Curved Bar tractor tire, Firestone now offers a complete line of tractor tires in several tread designs. The new tread design provides deeper penetration of soil and firmer bite that enables it to deliver maximum traction under all farming conditions. This is accomplished by extending the open bars past the center of the tire and having them curve to the shoulder. Each bar has a 24% taper from the outside shoulder to the sharper biting center section. Extra rubber in the center of the tread supporting each bar end makes the bars stronger and by this reinforcing of each traction bar, increases its service and life.

New Dewey & Almy Adhesive

A process for taping corners of corrugated boxes has been developed by the Dewey & Almy Chemical Co., Cambridge, Mass., and tested in extensive use by the Container Corp. of America. The process is said to cost no more than conventional methods and utilizes a new synthetic resin emulsion adhesive applied in liquid form to ungummed tape. The adhesive grew out of wartime experiments made by Dewey & Almy for the Army Quartermaster Corps for sealing "V" Boxes, the weatherproof container used for 10-in-1 rations. Previous versions of the adhesive have already been adopted by many companies including the Container Division of the International Paper Co. and the National Paper Co.

Bumper Cush-On Rubber Guards

Milwaukee Specialty Manufacturing Co., 1237 N. Jackson St., Milwaukee 2, Wisc., has announced the development of rubber bumper guards designed to cushion shock in minor collisions and parking. Named



Bumper Cush-ons, the product is made of high quality grey rubber one-half inch thick. Bumper Cush-ons are made in two sizes and will fit most cars. They come in convenient widths with non-rusting fastenings.

Science Information Service

Of interest to professionals and students in every field of science is the new time-saving service recently formed by the Science Book and Information Service, 471 Orange St., S. E., Washington 20, D. C. This organization, geared to the needs of scholars and researchers in an era of specialization, offers a many sided service. A worker specializing in any field may use its personal book-information section designed to meet his individual requirements. Those who have been seeking rare or out-of-print books may secure them through the service. Anyone who wants to be kept up to date on developments, whether in a specific subject or in general science, may do so through regular bulletins, issued monthly. These bulletins, available separately in each subject, supply comprehensive information (summaries, descriptions, listings) on every scientific and technical book of importance in the field, whether already published or forthcoming. Further information may be secured from the organization in Washington, D. C.

New Rubber-to-Metal Adhesive

General Tire & Rubber Co., Akron, Ohio, has developed Kalabond RM-2, a new type rubber-to-metal adhesive which is adaptable for bonding a wide range of metals to different types of rubbers. The new adhesive, based on a tailor-made polymer, reacts with both metal surface and rubber during vulcanization to form a positive chemical bond. Kalabond RM-2 is said to bond natural rubber, GR-S, nitrile rubbers, and neoprene to steel, stainless steel, aluminum, zinc, magnesium, brass, monel, and nickel. Other features, important in plant production, are its uniformity, stability, and ease of handling and application. The product contains no halogen and has definite anti-corrosive properties. Bonds made from the new product are highly resistant to aging, solvents and oils, and boiling water.

FIRESTONE FISCAL-YEAR NET FALLS BELOW TOTALS FOR 1948

According to the annual report of the Firestone Tire & Rubber Co., Akron, Ohio, net income for the fiscal year ended on October 31, 1949, amounted to $17,823,621 after all charges, including $5,169,652 reserve to cover foreign earnings which could not now be remitted. The income is equivalent to $8.81 a share on the common stock outstanding and compares with $27,674,344, or $13.34 a share, in the preceding fiscal year. Total sales for the year declined to $579,606,107 from $633,858,424 in the previous year.

Federal, state and foreign taxes amounted to $58,066,055, of which income taxes made a total of $12,350,000, excise taxes, $38,749,533, social security taxes, $3,088,517 and property and miscellaneous taxes, $3,878,005. Improvements of and additions to plant and equipment amounted to $19,157,385; compared with this expenditure, $15,425,362 was provided from current income and charged to depreciation.

Profits of foreign subsidiaries amounted to $11,505,386, but shortages of dollar exchange in some countries limited the remittance of dividends to $6,335,734. Devaluation of foreign currencies resulted in a reduction of $3,145,946 in dollar value of assets located in foreign countries, of which $806,021 was charged to income and the balance to a reserve provided from income in previous years.

The consolidated balance sheet as of Oct. 31, last, lists current assets at $215,948,315 and current liabilities at $47,020,133, leaving a net working capital of $168,928,182, against $160,716,782, a year earlier. Inventories were reduced to $117,308,771 from $139,534,370.

Offers New Flocking Service

A new method for flocking micro-cut rayon fibers on various types of rubber products has been developed by the Novelty Flock Printing Co., 75 Chamberlain Ave., East Paterson, N. J. Special machinery and special adhesives have been developed by the company to flock all objects and shapes on a production scale. Among products which have been given soft, velvety finishes at the sompany's plant are sponge balls, office chair cushions, toy animals, sponge pads, doll heads, and sponge pin cushions. Some 24 regular colors and at least 10 special colors can be applied. A color chart is available from the company on request.

Agricultural Bureau Appointments

Dr. Walter M. Scott and Dr. John R. Matchett have been appointed assistant chiefs of the Bureau of Agricultural and Industrial Chemistry of the U. S. Department of Agriculture. Dr. Charles H. Fisher has been named to succeed Dr. Scott as director of the Bureau's Southern Regional Research Laboratory in New Orleans. Dr. Scott, who has directed the New Orleans laboratory for the past 3 years, will serve in Washington as coordinator of the Bureau's research on utilization of cotton, other fiber crops, and agricultural residues.

Morris Enters Consulting Field

H. B. Morris

H. B. "Hap" Morris, associated with the Eagle Rubber Co. as technical director since 1947, has resigned from that organization to establish a consulting service for the rubber, plastic and allied industries. The service offered will include production, development, research, design and sales, and will cover rubber chemicals as well as rubber and latex products. Mr. Morris has been associated with the rubber industry since 1931 and has served with Firestone, Naugatuck Chemical, Killian and Shunk, in addition to Eagle Rubber. From 1942 to 1945 he served with the Chemical Warfare Service, retiring as a captain. Mr. Morris will also devote more time to the M. & M. Foundation, Inc., as its president. M. & M. Foundation, Inc., is an organization devoted to the development, manufacture, licensing and distribution of special products.

Summers Forms Own Company

William H. Summers, formerly district manager for the Goodyear Tire & Rubber Co. in Cleveland, Ohio, has formed his own company to take over distribution of the Boston Woven Hose & Rubber Co. in the Cleveland area. Mr. Summers was associated with Goodyear's Mechanical Goods Division for 25 years. He was manager of the Airfoam Division at Akron, district manager at Boston, Mass., and district manager in the Cleveland area. During the war years he worked in Washington, D. C. The new organization, W. H. Summers Co., will distribute the entire mechanical goods line of Boston Woven Hose. The firm is located at 400 Lakeside Avenue West, Cleveland, Ohio.

Bray Appointed Genseke Agent

Fred V. Bray, P. O. Box 166, Melrose, Mass., has been appointed to handle the sale of mold lubricants, plasticizers, etc., produced by Genseke Brothers, 4831 South Whipple St., Chicago 32, Ill.

OCTOBER CASING PRODUCTION 16% ABOVE SEPTEMBER TOTALS

Production of automotive casings during October totaled 6,500,017 units, 15.99% more than the 5,603,741 casings produced in September, according to a report of the Rubber Manufacturers Association. Passenger casings produced in October amounted to 5,621,182 units, 13.54% more than the 4,950,727 passenger casings produced the month before. Truck and bus casings also showed increases production-wise with 878,835 casings in October, 34.58% above the 653,014 truck and bus casings produced in September.

In October, a total of 6,839,604 casings of all types were shipped, including 5,784,685 passenger casings and 1,054,919 truck and bus casings. In the previous month a total of 6,746,253 casings were shipped, including 5,820,969 passenger casings and 653,014 truck and bus casings.

Inventories were reduced during the month, and at the end of October 8,674,882 casings were on hand, 2.93% less than the 8,936,213 casings on hand at the end of September. At the end of October, 7,015,899 passenger casings and 1,658,983 truck and bus casings were on hand, compared with 7,124,640 and 1,811,573, respectively, on hand as of September 30.

During the month of October, a total of 5,295,630 passenger and truck and bus tubes were produced, compared with 4,902,319 tubes the month before. Tubes shipped during October numbered 5,557,104 units, against the 5,842,812 tubes shipped in September. As of October 31, there were 8,643,678 tubes on hand, contrasted with 8,915,678 tubes on hand on September 30.

Super Hi-Cleat Tractor Tire

B. F. Goodrich Co., Akron, Ohio, has announced a tractor tire of new design named the Super Hi-Cleat. The tire incorporates a new feature, the "Power Curve" tread so designed that tire life will be greatly increased, the company said. Farmers who drive their tractors over highways will find that the ride is much smoother than formerly. The "Power-Curve" treads feature higher cleats for deeper penetration, extra traction. The cleats are scientifically placed exactly parallel to form a channel for natural self-cleaning without any obstructions. The forward points of the cleats are offset or staggered so they do not obstruct each other's function of soil penetration. The design also includes a new furrow strip, a band of thick rubber on the shoulder which increases tire life by resisting rubbing against the side of the furrows. Another new feature is the raised edge formed on the sidewalls by the extension of the cleat design, giving extra traction in deep or sandy soil.

Plastic Wire & Cable Corp.

Year to October 1: Net loss of $57,207, against a net loss of $19,948 the year before. Net sales for the year ended October 1, 1949, totaled $2,026,728, compared with $2,307,165 in the previous year.

OBITUARIES

Olin C. Work

Olin C. Work, popular and widely-known technologist who had been associated with the rubber manufacturing industry for the past thirty years, died at his home in Morrisville, Penna., on November 17, 1949. He had been in ill health for the past few years and death was attributed to a sudden blood clot. He was 55 years of age.

Born at Exeter, New Hampshire, on August 28, 1894, Mr. Work was graduated from the University of New Hampshire in 1916 with a B.S. in Mechanical Arts. For the three years following graduation he was associated with the L. S. Starrett Co. of Athol, Mass., as an experimental toolmaker, and in 1919 he entered the rubber industry by joining the Goodyear Tire & Rubber Co. at Akron as a tire and tube engineer under W. E. Shively, remaining in that post for two years.

In 1921 Mr. Work joined the Seiberling Rubber Co. of Canada as assistant factory manager and held that position until 1928 when he became associated with the former India Tire & Rubber Co. at Mogadore, Ohio, as production manager. He remained with India Tire until 1934, during which time he developed the basic idea of what later became the now well-known DeMattia Flexometer. From 1934 to 1941 he was factory manager for the former Overman Cushion Tire Co. at Belleville, N. J., where he designed and patented one of the first silent squeegee tires.

From 1941 to 1943 Mr. Work was a development engineer for the L. H. Gilmer Co. at Philadelphia, now a division of U. S. Rubber, and in the 1943-44 period he was works manager of the Vulcanized Rubber & Plastics Co. at Morrisville, Penna. In the 1944-46 period he was plant manager of the Ideal Rubber Co. at Brooklyn, N. Y., and in the latter part of 1946 joined the Rodic Rubber Corp. at Garwood, N. J., as vice-president and plant manager. He left the Rodic organization in late 1948 and for the past year or so had operated a self-service laundry in Trenton.

A member of several rubber associations, Mr. Work was also a member of the Akron University Club, the Trenton Country Club, Masonic Blue Lodge of Athol, Mass., Sigma Alpha Epsilon Fraternity, and the First Congregational Church of Akron. Funeral services were held on November 21, with interment in Rose Hill Burial Park. His widow, Lucille, survives.

Walter F. Morton

Walter F. Morton, industrial sales representative for the Socony-Vacuum Oil Co., died unexpectedly of a heart attack at his home in Akron, Ohio, on December 21. He was 62 years old. A native of Cincinnati, Ohio, Mr. Morton came to Akron for Socony-Vacuum 20 years ago. He was a member of the Akron City Club and the Sons of the American Revolution. He leaves his wife and a son.

Louis J. de Holczer

Louis J. de Holczer, manager of the Rubber Division of the Crown Cork & Seal Co., Baltimore 3, Md., died on December 23 at his eldest son's residence in Orlando, Florida. A native of Merza, Hungary, Mr. de Holczer was a graduate of the Royal Hungarian University of Budapest. He came to the United States in 1913, and was employed by the Firestone Tire & Rubber Co. as a chemical engineer. During his 36 years in the rubber field, he was also connected with B. F. Goodrich Co., U. S. Rubber Co., Gates Rubber Co., and Jenkins Bros. He had been associated with Crown Cork for the past 13 years. Services were held in Fairchild Funeral Home in Orlando on December 23. The body was forwarded to Bridgeport, Conn., where a Requiem High Mass was offered on December 27, with interment in St. Michael's Cemetery. Mr. de Holczer is survived by his wife and three sons.

James B. Miller

James B. Miller, rubber supervisor for the Firestone Tire & Rubber Co. at Christ Church, New Zealand, died of a heart attack on November 27 while playing tennis at a New Zealand vacation resort. He was 47 years old. Born in Raymond, W. Va., Mr. Miller had been associated with Firestone's Plant One in Akron, Ohio, for 28 years. He also served in the Aircraft Division for 3 years, and had served at Firestone's plant in England for a year, and in Bombay, India, for a year. At the time of his death he had been in New Zealand for 18 months. Services were conducted on December 23 at Firestone Park Methodist Church near Akron, with interment at Greenlawn Cemetery. His wife and two sons survive.

Clare N. Suffill

Clare N. Suffill, sales promotion manager for the Fisk Division of the U. S. Rubber Co., New York 20, N. Y., died on December 28 at White Plains Hospital in White Plains, N. Y. He was 53 years old. A native of Kalamazoo, Mich., Mr. Suffill joined U. S. Rubber in 1919 in a sales promotion capacity. He was transferred to the firm's general offices in New York in 1924 and later worked for the company in Detroit, Mich. He resigned from U. S. Rubber in 1930, rejoining in 1943 with the Fisk Tire Division, where he eventually became sales promotion manager. He was a member of the New York Sales Managers Club. Services were held on December 28 at Greenville Community Church, Scarsdale, N. Y.

Who makes rubber band cutting machines? Tread slitters? Take-Off apparatus? The answers are in the 1949 RUBBER RED BOOK. Price: $5.00 per copy.

Herbert J. Long

Herbert J. Long, technical representative for the Naugatuck Chemical Division of the U. S. Rubber Co., in the Chicago and Detroit area, died on November 14 at the age of 59. Mr. Long was born on January 6, 1891, in Jamestown, Ohio, and attended the public schools of Columbus, Ohio, and Johnstown Penna. He was a graduate of the College of Engineering of Ohio State University. On leaving college, he joined the Goodyear Tire & Rubber Co. at Akron, Ohio. Later, he was sent to Canada as assistant manager of Canadian Goodyear. During World War I he was in charge of pyrotechnics for the Trench Warfare Division of the Army Ordnance Department. After the war he went with the Nixon Nitration Works of New Jersey as a division sales manager. This association lasted for 19 years. In 1937, he joined Naugatuck. Mr. Long was a Mason, a member of Sigma Alpha Epsilon, and the 25-Year Club of the American Chemical Society. He was also a member of the Chicago and Detroit Rubber Groups. His widow, a son and a daughter survive.

Fletcher P. Thornton

Fletcher P. Thornton, a director of Stowe-Woodward, Inc., Newton Upper Falls, Mass., and vice-president of the W. E. Greene Corp., New York, N. Y., died on December 18 at his home in Summit, N. J. He was 63 years old. Born in Baltimore, Md., Mr. Thornton had been associated with W. E. Greene, sales organization for mechanical rubber goods, for 30 years. He was a Mason and a member of the Brook Country Club, Millburn, N. J. Private funeral services were held on December 19. His widow and three sons survive.

Henry H. Nance

Henry H. Nance, assistant treasurer of the U. S. Rubber Co. until his retirement in 1930, died on December 17 at his home in Cambridge, Mass. At the time of his retirement he was also treasurer of the Stoughton and American Rubber Companies. During the recent war, Mr. Nance did special work for the War Department at the Balloon Barrage Training Center, and also worked for Consolidated Vultee Aircraft Corp. He is survived by a son and a daughter.

Walter E. Hansen

Walter E. Hansen, purchasing director of the Lee Rubber & Tire Co., Conshohocken, Penna., died on December 20 in Paoli General Hospital, Paoli, Penna. He was 54 years old. During his business career, Mr. Hansen was associated with the Firestone Tire & Rubber Co. in Akron, Ohio, from 1916 to 1924. He left Firestone to join Lee Rubber as purchasing director in 1924, the position he held until his death. His daughter survives.

Tire Discount Hearing Delayed

The nation's major tire producers have obtained another extension in the Federal Trade Commission's quantity tire discount case. On December 9, the FTC extended until January 19 the deadline for filing written briefs in the case. Presentation of oral arguments before the commission are scheduled to begin in Washington, D. C., on February 7. Earlier, the FTC had set January 9 as the date for oral presentations. The case concerns the proposed 20,000-pound limit above which tire makers may not grant discounts to their wholesale and retail customers. FTC proposed the limitation last October 4. The Government agency said that it had been studying the complaints of small tire dealers for two years. These dealers claim the big wholesale buyers have been able to add to their stocks at less than the smaller dealer's costs. If adopted, the regulation would fix a carload of tires, 20,000 pounds, as the maximum on which tire makers could grant discounts because of quantity purchases.

G-E Develops X-Ray Microscope

An X-ray microscope, which makes visible internal details of materials through which light cannot pass, has been developed by the General Electric Co., Schenectady 5, N. Y. The X-ray microscope does not require that samples under study be in a high vacuum, as does the electron microscope. According to G-E officials, clear, sharp X-ray images, magnified ten times, have been produced in the laboratory, and these images have been magnified ten times further by photographic enlargement without serious loss of detail. Thus, at the present stage of development, magnifications of 100 diameters have been produced. Future refinements of the X-ray microscope, at present in the laboratory stage of development, may result in much sharper images and higher magnifications than are possible using visible light.

Harris Products Enlarges Plant

Harris Products Co., Cleveland 3, Ohio, has enlarged its rubber plant facilities in Milan, Ohio, with the erection of a Lustron prefabricated structure which will be used as an office building. The 31 x 34 foot all metal building will serve as the main office building and will be connected to the factory proper by an intercommunication telephone system. A new testing laboratory is housed in a recently completed 80 x 100 foot cinder block addition to the main building. Operations carried on in the new section include sorting, trimming, inspecting, shipping, etc. Space is also provided for storage of finished products and slab stock. Four new presses have been added to the equipment in the factory which will enable the plant to double its production of rubber bushings.

A 42-foot, 3-inch Farrel rubber roll grinder was recently installed at the plant of Stowe-Woodward, Inc., at Newton Upper Falls, Mass. It is believed to be the largest grinder of its type to be put into operation in this country.

Rubber Cutter Fire

In a rubber factory in New England, an employee placed a bale of crude rubber in a cutting machine having an electrically heated knife. He left the area, the rubber ignited, and the operator discovered the fire on his return. Nineteen sprinklers operated and checked the fire, although sprinkler water was unable to reach the seat of the fire because of a wide belt conveyor. Public firemen and employees finally extinguished it with several large hose streams. Motors, wiring, controls and machinery were damaged, and several bales of crude rubber destroyed. Sprinklers are usually needed under wide conveyors. Replacement of the electrically heated knife with a modern cold knife cutter is being considered.—*Factory Mutual Record.*

Street Named for Fresneau

In recognition of the achievements of Francois Fresneau, often called the "Father of the Rubber Industry," the "Avenue Francois Fresneau" was recently dedicated in Paris, France, at ceremonies sponsored by the Paris Municipal Council, the French Rubber Institute, and the Association of French Overseas Engineers. The "Conseil Superieur" of the French Rubber Institute took the initiative in requesting recognition of Fresneau's achievements. The new "Avenue Francois Fresneau" is in the vicinity of the Bois de Vincennes. Francois Fresneau, a resident of Guiana in the 1740's, is credited with having been the first white witness of rubber collecting in all its details and one of the earliest advocates of the use of rubber in the manufacture of various products, including tarpaulins, hose and divers' suits. His observations on rubber were published in France by his friend, Charles Marie de la Condamine, a member of the Paris Academy of Science, also acknowledged as a pioneer of the rubber industry.

IRI Organizes Rubber Conference

The London Section of the Institution of the Rubber Industry is organizing a conference on the behavior and testing of rubber under dynamic conditions. The conference will be held in London on March 17. Arrangements have been completed for the presentation of six papers to be prepared by experts from the rubber industry and rubber research establishments. The conference will consist of a morning and an afternoon session. Preprints of the papers will be circulated before the meeting to interested parties. The proceedings of the conference will be published in a special issue of *Transactions of the Institution.* Those wishing to attend the conference are requested to write the Institution of the Rubber Industry, 12 Whitehall, London, S.W. 1, England.

Consumption in November Falls

New rubber consumption for the month of November was down slightly to 83,153 long tons from the 84,278 tons used in October, according to the monthly estimate of the Rubber Manufacturers Association. The use of natural rubber increased 1½% during November to a total of 51,561 long tons, compared with the 50,797 tons used in the previous month. Use of synthetic rubber, however, declined 5.64% to 31,592 tons, as against 33,481 tons in October. Consumption of reclaimed rubber in November was estimated at 19,375 long tons, a decrease of 1.33% from October, when 19,635 long tons were used. The eleven months' total of new rubber consumed was 903,666 long tons, as against 992,310 tons for the first 11 months of 1948, a decline of about 9%. In the first 11 months of 1949, 522,925 long tons of natural rubber, 380,741 tons of synthetic rubber, and 205,329 tons of reclaimed rubber were consumed, compared with 577,484 tons of natural, 414,826 tons of synthetic and 252,072 tons of reclaimed consumed in the first 11 months of 1948.

DeVilbiss Executives Promoted

Promotion of five company executives was recently voted by the board of directors of the DeVilbiss Co., Toledo, Ohio. Effective January 1, 1950, William A. Delger, former plant manager, became vice-president in charge of manufacturing; Don J. Peeps, chief engineer, was advanced to vice-president in charge of engineering; John M. Robinson, treasurer, was elected vice-president and treasurer; Frank R. Pitt, the company's legal counsel, was named secretary, and R. Miles Booth, member of the treasurer's staff, was appointed assistant secretary and assistant treasurer. Mr. Delger joined DeVilbiss in 1946. Mr. Peeps entered the company's employ in 1928 as a factory worker, becoming chief engineer in 1944. Mr. Robinson joined DeVilbiss in 1946 as treasurer, while Mr. Pitt is legislative chairman of the National Paint, Varnish and Lacquer Association.

Dr. Jeffries Retires From G-E

Dr. Zay Jeffries, vice-president in charge of the Chemical Department of the General Electric Co., has retired from active service with the company. Dr. Jeffries began his service with General Electric in 1914 as a consultant to the National Lamp Works. From 1932 to 1936 he was also president of the Carboloy Co., Inc., a G-E affiliate, and since then has been a member of the board. In 1936, he became technical director of the G-E Lamp Department. In January, 1945, Dr. Jeffries was elected a vice-president of the G-E board of directors and placed in charge of the newly-formed Chemical Department, a position he held until his recent retirement. Dr. Jeffries has received many different honors and awards during his career. He belongs to many technical, scientific and fraternal societies, and is a trustee of Case Institute of Technology and Battelle Memorial Institute.

CANADIAN NEWS

Joseph MacKenzie, director of the Canadian unit of the United Rubber Workers of America, has been dismissed along with three members of his staff. Trade union leaders at Toronto expressed the belief that the dismissals came as a reprisal move by L. S. Buckmaster, head of the international union. Mr. MacKenzie was a member of the URWA executive board which suspended Mr. Buckmaster last spring for allegedly interfering with the autonomy of local unions in the United States. Mr. Buckmaster was subsequently reinstalled. President of the Ontario Federation of Labor and an executive member of the Canadian Congress of Labor, Mr. MacKenzie has been replaced as Canadian URWA director by Norman Allison, president of the Goodyear local at Bowmanville, Ontario.

Arthur F. Andrews, formerly with the Fabrikoid Division of Canadian Industries, Ltd., as plastics group leader, has joined Canadian General Tower Ltd., Galt, Ont., as plastics development supervisor. Mr. Andrews was graduated from Queen's University in 1942 with a B.A. degree.

Construction was recently started on a new chemistry laboratory building at the Montreal Road Laboratories of the National Research Council near Ottawa. When the new building is completed, probably by late 1950, the staff of the applied chemistry branch of the Division of Chemistry will move into it. This branch is now located at the Sussex Street Laboratories.

A 10% increase across the boards on all of its tires and tubes was announced by the Goodyear Tire & Rubber of Canada, Ltd., last month. Although at this writing no corresponding increase has been announced by other Canadian tire manufacturers, it is believed that such announcements are pending and that the Goodyear increase will serve as a pattern for the entire industry.

In making the announcement, C. B. Cooper, Goodyear general sales manager, said that his company had made substantial reductions in prices in 1947, despite increases in costs of manufacturing and distribution. The new prices, he said, would still be lower than the 1940 level in most of the popular tire sizes and the motorists will be getting greater value for his money than ever before "due to the steady improvement in quality of our tires."

In Canadian tire circles it was stated that the basic reasons for the price increase included increases in taxes, higher labor and material costs, higher freight rates, and devaluation of the Canadian dollar.

Sales of the Canadian Tire Corporation have shown a substantial increase for the first eleven months of 1949 as compared with the corresponding period of 1948 and were at an all-time high, according to J. W. Billes, president. Profits, while not definitely determined at the time of the report, should allow a corresponding improvement. Dividend payments for 1949 totaled $1.50 a share, the best in the company's history, and compare with $1.40 and $1.25, respectively, for 1948 and 1947. Earnings for 1948 were equal to $4.33 a share.

Elliot McLaughlin

Newly elected chairman of the Los Angeles Rubber Group.

The $3.00 dividend recently declared by the Goodyear Tire & Rubber Co. of Canada was "just a three-dollar dividend," company officials have stated. The common stock of the company has never been placed on a regular dividend basis. Total payments on the common stock for 1949 will be approximately $6.00 per share, which compares with $7.50 per share in the preceding year.

Film on Plastics Available

The Society of the Plastics Industry, Inc., 295 Madison Ave., New York 17, N. Y., has announced the availability of a motion picture entitled "The Scientific Approach to Better Plastics." The film, completed last year, depicts the plastics research project in operation at Massachusetts Institute of Technology, and has been shown to technical audiences in the United States and abroad. Prints of this 20-minute, 16mm sound and color film are available free of charge to educational institutions of the advanced high school and college level, as well as any industrial organization, by application to the SPI.

History of Industrial Rubber Co.

Continuing its series of articles outlining the history of various rubber manufacturing concerns, the December 15, 1949, issue of *The Royle Forum*, house organ of John Royle & Sons, Paterson 3, N. J., is devoted to the history of the Industrial Rubber Goods Co. of St. Joseph, Mich. The company, which is headed by Fred C. Palenske, was organized in February, 1919. Some interesting interior views of the company's plant are shown in connection with the article.

LOS ANGELES NEWS

Approximately 420 members and guests of the Los Angeles Rubber Group attended the annual Christmas Party held on December 9 at the Los Angeles Breakfast Club in Los Angeles, Calif. The meeting featured the installation of officers for the 1950 season. A social hour preceded the serving of a dinner and dancing. Each of the ladies attending the meeting was presented with a table favor in the form of a French imported combination lipstick holder and mirror.

Officers installed for the 1950 season of the group included: *Chairman*, Elliot McLaughlin (H. M. Royal); *Associate Chairman*, R. D. Abbott; *Vice-Chairman*, R. L. Short (Kirkhill Rubber); *Secretary*, Carl Hoglund (Goodyear); *Treasurer*, L. E. Budnick (Ohio Rubber).

The following members were named directors for the 1950 season: D. C. Maddy (Harwick Standard Chemical), A. J. Hawkins (DuPont), and William J. Haney (Kirkhill Rubber). In recognition of his many contributions to TLARGI since its organization in 1927, Raymond B. Stringfield of the Fullerton Manufacturing Co., Fullerton, Calif., was made an Honorary Life Member. During the 23 years of the group's activities only one other member has been awarded this honor, Edward L. Royal of the H. M. Royal Co., Inc., Los Angeles, Calif.

Mr. McLaughlin, the newly-elected chairman, was graduated from Renssellaer Polytechnic Institute of Troy, N. Y., in 1928. From 1928 to 1946 he was employed by the B. F. Goodrich Co. in various capacities, serving in their Akron, Ohio, Oaks, Penna., and Los Angeles plants. In 1946, he resigned and accepted a position with the H. M. Royal Co. in the field of chemical sales of raw materials to the rubber industry.

Ems Heavy Duty Mold Cleaner

Ems Heavy Duty Mold Cleaner No. 57, described as a completely new and highly effective material for cleaning steel and chromium molds used in the rubber and allied industries, was recently introduced by the E. W. Smith Chemical Co. of Los Angeles, Calif. The cleaner is reported to strip all forms of carbon and organic matter from molds without injury of any kind to the molds themselves and without leaving any traces of pitting or etching. The most effective method of application is by the hot dipping process. Smith Chemical recently appointed George Steinbach of the Merit Western Co., 1248 Wholesale St., Los Angeles 21, Calif., as distributor for Ems Heavy Duty Mold Cleaner No. 57 on the Pacific Coast.

Oakland Textile Changes Name

The Oakland Textile Co., 381 Fourth Ave., New York 16, N. Y., manufacturers and distributors of fabrics for the rubber and allied industries, has changed its name to the Kranish Textile Corporation. The change was effective as of January 1, 1950.

THE STORY BEHIND THE WORD...

SALARY...

During the days when the Roman Legions ruled most of the known world, salt was so scarce that it was considered as valuable as precious metals. As a consequence, the soldiers preferred to receive a part of their pay in salt. This salt money, or Salarium later became the word "salary" as we know it— a recompense paid for services rendered in business or the professions.

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NEW RUBBER GOODS

Sperry Top-Sider Footwear

Sperry Top-Sider Footwear, Beacon Falls, Conn., has announced the availability of three shoe styles, all with non-skid rubber soles. Additions to the 1950 line include the Commodore Oxford for men and women in jeans blue denim, a light weight boot for wear over socks and a high cut rubber. All have special non-

skid soles to produce surefootedness on wet, slippery, heeling decks and on docks. The non-marking white sole also protects the finish of decks and brightwork. The light weight over-the-sock rubber boot, called Top-Sider Klingtite, is designed to give complete protection to hardy cruisers, deep sea and racing enthusiasts in foul weather. It is made in two heights, one just below the knee and one to the middle of the thigh. The high cut rubber, for wear over leather shoes, gives waterproof protection and sure footing on wet or dry surfaces.

Snyder Rubber Apron Fastener

M. L. Snyder & Son, Philadelphia 25, Penna., has introduced a new apron clip which may be used on any aprons with grommets in the side corners. The elastic

rubber belt fastens behind the apron securing the ends in even manner, so that no grommets are torn out or any aprons ripped. The apron clip is adjustable to fit any size person, and may be washed.

Glass-Filament Adhesive Tape

Minnesota Mining & Manufacturing Co., St. Paul 6, Minn., has introduced the latest in its line of glass-filament industrial adhesive tapes. This latest tape, No. 890, uses a rubber adhesive applied to an acetate film-backing. Imbedded in the adhesive are thousands of glass filaments that run parallel with the tape. The company states that each inch of tape width will take a pull of 500 pounds. Earlier versions of the tape had strengths of 175 pounds per inch of tape width. Glass-filament tapes find application in strapping fiberboard cartons, banding steel coils and pipes. The tapes will be available in the spring in widths of ½, ¾ and 1-inch.

Rubber Roost Mats for Shoes

Designed to keep slush and mud off floors, Rubber Roosts, manufactured by the Rubber Roost Co., 522 Rossmor Bldg., St. Paul 1, Minn., provide a practical mat for overshoes and boots. The Rubber Roost is

a mat with turned-up edges which has been cut in a design to fit a pair of overshoes or rubbers. Deep corrugations in the mat surface speed evaporation. Rubber Roosts also nest together for easy storage. When placed inside or outside the door of the home they should prevent tracking through the house. Rubber Roosts are made in various sizes so that each member of a family may have his own.

Farm Fuel Dispensing Hose

A new light weight, high strength hose designed for refueling tractors and other motorized farm equipment from either barrel or tank has been developed by the U. S. Rubber Co. The hose is constructed with an oil-resistant tube made of neoprene, a rayon braid carcass, built-in static wire and a rubber cover especially designed to withstand abrasion. The hose is available in sizes ranging from ⅝ inch to one inch inner diameter in either specified cut lengths or random factory lengths. It will be marketed under the name U. S. Rainbow Farm Fuel Dispensing Hose.

Busy Lizzy Rubber Novelty

Bayshore Industries, Elkton, Md., has introduced a realistic rubber novelty, Busy Lizzy, a green lizard. Busy Lizzy is 6

inches long and 1 inch wide and so completely flexible that legs and tail quiver at the slightest touch. The heavy rubber material weights her so that she balances realistically even on a ledge. Her body has scales molded in.

Thermo-Mat Radiant Heat Unit

Thermo-Mat, a new foot warming unit for home and factory, has been introduced by the Thermo-Mat Co., 814 So. Robertson Blvd., Los Angeles 35, Calif. The unit is constructed of long-life flexible rubber covering the heating element. Thermo-Mat measures 14 x 22 inches and is 5/32-inch thick. It is equipped with a 6-foot

approved cord and plug ready to plug into any 110-120 volt receptacle. The unit consumes about 150 watts after it has come up to 120° F., which is standard foot warming temperature. Thermo-Mat finds use on cold factory or office floors, or in the home. It may also be used to maintain solutions in pans and trays at constant temperature, and in small enclosures to maintain temperatures, and many similar applications. The mat resists oils and acids and may be washed with soap and water.

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More Than
1,000,000
Tire Miles

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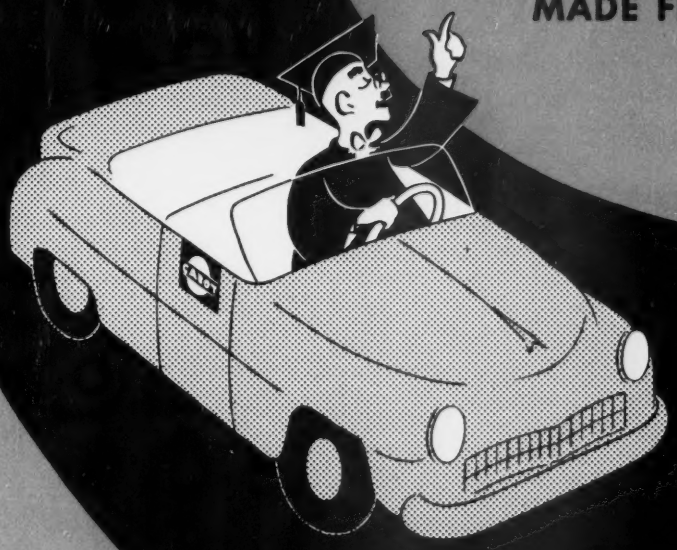
A CABOT HAF BLACK
MADE FROM OIL



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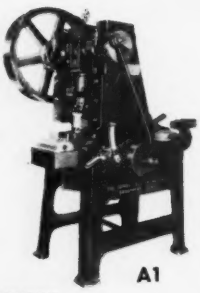
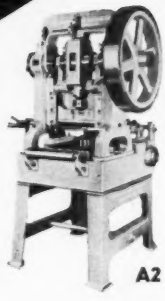


A1

Men who Know PRODUCTION MACHINES Choose

the James COULTER Machine Co.
BRIDGEPORT, CONN.

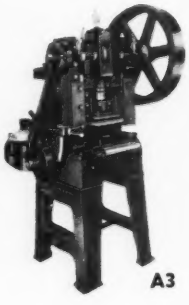
MODEL A-1
Cutting Heels at high speed production or short runs.



A2

MODEL A-2
Cutting Multiple Heels, Half and Full Soles with stock grain.

MODEL A-3
Cutting Multiple Heels and Taps with or across stock grain.



A3

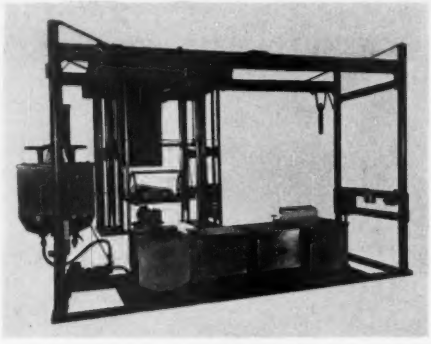
MODEL A-2s
(Not illustrated)
Cutting across grain of stock.

COULTER PRODUCTION MACHINES SINCE 1896

NEW EQUIPMENT

Experimental Latex Dipping Unit

Illustrated herewith is a laboratory experimental or pilot control dipping plant manufactured by the Miami Boiler & Machine Co., 764 Miami St., Akron, Ohio. The unit is equipped with a dip rack to receive a removable aluminum panel 24 inches square by ¼-inch thick. The minimum speed of dipping in either direction is 3/32-inch per minute and stepless control up to a maximum



of 200 inches. The motor, mounted on a special panel to drive the shaft and disc extending below, rotates a form during immersion, dwell and withdrawal.

The large tank suspended at the left is of stainless clad steel with a partition through the center, forming two compartments, one to hold 100 gallons of rubber latex and the other for synthetic latex. Each compartment is equipped with a small circulating unit to circulate the emulsion periodically. The stainless steel circulating dip tank below the dipping machine is filled by gravity from the storage tank and when desired can be pumped back into storage. The two succeeding stainless steel tanks are for coagulants, while the fifth tank is for leaching. The leaching tank is electrically equipped with automatic control for heating a constant flow of water.

Stabilflo Control Valve

Quick reversibility of action is the feature of a new air-operated Stabilflo Valve produced by the Foxboro Co., Foxboro, Mass. In a few minutes time, and without the use of special tools, the valve can be changed from "air to open" to "air to close," or vice versa; and it is not necessary to remove the valve from its installation or to shut down the controlled flow. The new Reversible Motor with its forged steel motor housing is similar in general appearance to the conventional Stabilflo Valve. To reverse the action of the valve motor it is only necessary to remove the housing assembly, rotate it one quarter turn, and replace it. This merely requires the removal and replacing of four bolts, which is easily done with an ordinary wrench.

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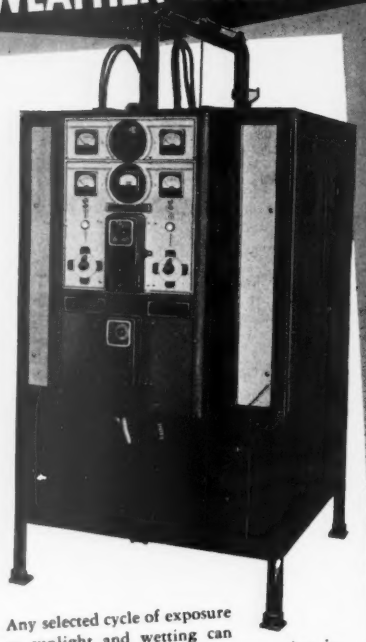
RUBBER PRODUCTS
determined with reliable
accuracy in the

ATLAS *twin arc*
WEATHER-OMETER



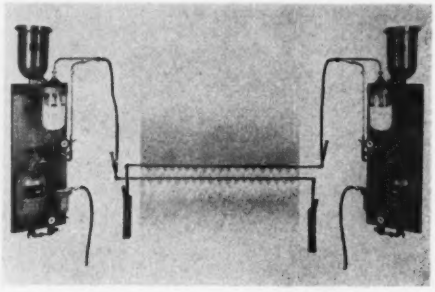
Any selected cycle of exposure to sunlight and wetting can be set for automatic continuous testing in the Weather-Ometer. Exact tests can be duplicated at any time by settings on the control panel which contains temperature regulator—time meter—light and water cycle switch — automatic cut-off switch — voltage adjusting switch — direct reading thermal regulator — reactance coil (for economical current consumption). The Weather-Ometer is fully automatic in operation; can be left unattended over night; only necessary to renew carbons once in 24 hours. Years of exposure to any conditions of weathering reduced to a few days testing in the laboratory with the Weather-Ometer.

Originators and sole manufacturers of accelerated testing machines for over a quarter of a century. Fade-Ometer, Weather-Ometer, Launder-Ometer — the accepted standard testing machines used all over the world.

ATLAS ELECTRIC DEVICES CO.
361 West Superior Street, Chicago 10, Illinois

Craig Dri-Spray Unit

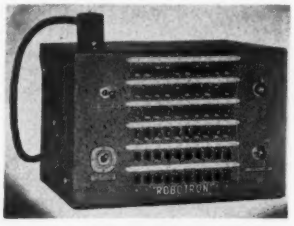
Originally intended for use in the graphic arts industries for automatically applying powder particles between printed sheets to prevent sticking, etc., the Craig Dri-Spray Unit manufactured by the Payne & Craig Corp., 82 Beekman St., New York 7, N. Y., has proved to be



of utility in numerous other applications. Model P6G, depicted herewith as two units used in typical plastics film application, may be used in the automatic dusting of rubber sheeting, tubing and kindred products. It will spray dry powdered resins for making coated fabrics and also for laminating purposes. Model P6G is panel mounted on ¼-inch plywood, size 12 by 32 inches. The unit will spray at low pressure a minimum of one ounce to a maximum of approximately six pounds of powder per hour. Operation is automatic by means of solenoid control, actuated by the starting and stopping of the machine, either for continuous or intermittent spraying.

Robotron Hydraulic Press Control

Designed to perform automatic bumping or breathing operations on hydraulic presses, the Robotron hydraulic press control unit, manufactured by Emmett Machine & Manufacturing, Inc., 2249 Fourteenth St., S. W., Akron 14, Ohio, can be set to give from 1 to 40 "bumps"



during any one cycle of operation and to control the over-all cure time. Robotron Model 140-X is equipped with three built-in time arrangements, any one of which can be selected by the "flick" of a switch. The unit is wired for use with limit switches to regulate the amount of press opening during the bumping operations, to close the press after a predetermined time, and to hold the press closed until the next bump. Once predetermined cure time and bumping arrangements are set, the press will continue through the cycle without additional attention. An accessory attachment is available for locking the unit after setting to prevent tampering.

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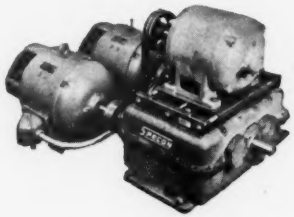
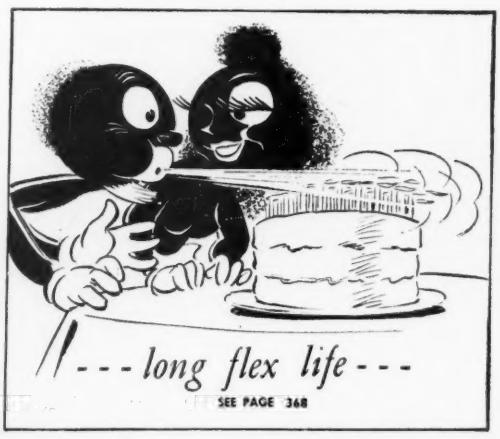
Electrical Differential Speed Drive

Infinite speed ranges, down to and including zero speed, with constant torque, under fully automatic control, is possible with a newly designed Electrical Differential Speed Drive recently perfected by Speed Control, Inc., 1272 Depot Street, Wickliffe, Ohio. In the processing of web materials, constant tension or decreasing tension may be maintained between a machine and a winding stand or between two parts of the processing machine, assuring a smooth, even flow of material.



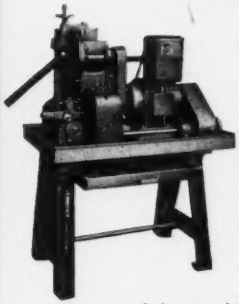
The new drive, designated as Specon ED, makes use of a unique motor generator combination. The unit consists of a standard AC squirrel cage motor of any desired voltage and frequency (or any prime mover of constant rpm), two d-c motors and a differential gear box. The a-c motor, or prime mover, is coupled with 2 d-c motors through the differential gear box. The d-c motors are connected in a closed circuit and require no outside source of power.

In operation, the d-c motors run at varying controlled speeds within a limited 3:1 range and are the means of controlling the torque and unlimited speed of the output shaft. Because the differential gearing requires no more attention than an ordinary speed reducer, and the motors are of standard make and interchangeable, the unit provides dependability with a minimum of maintenance. The driving motor may be mounted either horizontally or vertically and the unit is available in any required size and capacity; Current installations include rubber, paper and other web applications.



SEE PAGE 368

For Immediate Shipment..
Thropp Automatic



Washer Cutters

THE Thropp Automatic Washer Cutter does not require mandrels. It will cut washers for hose connections, bottle stoppers, plumbers' washers, synthetics, uncured stock for molds, etc. A single unskilled operator can run one or more of these machines at the same time. Size of Cuts: ¼" in diameter to 1¾" inclusive, and from 3/32" to 1½" in length.

Capacity: 100 cuts per minute on long lengths and big diameters; and 200 cuts per minute on narrow widths and small diameters.

Shipment: Shipment can be made from stock on a limited number of units complete with motor and control, wired and ready for installation.

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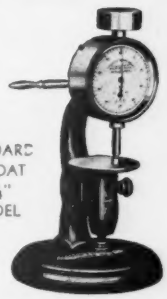

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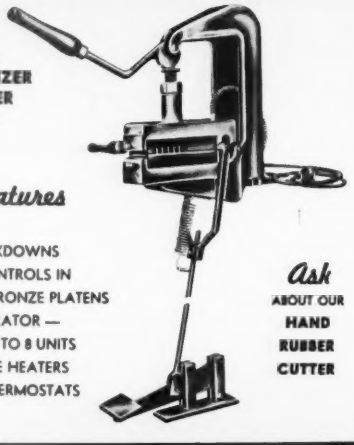

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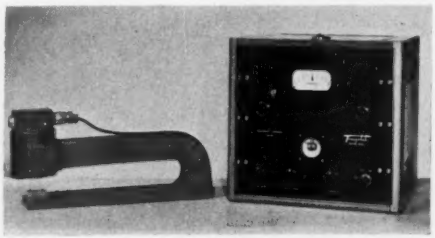
Tracerlab SM-3 Beta Gauge

No physical contact is made with the material being measured by the SM-3 Beta Gauge produced by Tracerlab, Inc., 130 High Street, Boston 10, Mass., the second of a series of industrial measuring and control instruments currently under development using radioactive



isotopes. The essential components of the gauge are a source of beta radiation from Strontium-90 and a radiation detector. The sheet material to be measured is interposed between the source and the detector and a part of the radiation is absorbed by the sheet material in proportion to its weight per unit area.

The standardizing procedure with this model requires that the moving sheet material be broken once every 8 hours while the instrument is balanced to compensate for various factors which may have caused it to drift. It will measure the weight per unit area of continuously moving sheets of material up to 700 mg/cm² and provide an indicatio when manufacturing tolerances are exceeded.

A few typical uses of the Tracerlab Beta Gauge are measuring rubber and plastic sheets and thin plastic films up to 3/16-inch thick, paper ranging from heavy board to extremely thin condenser paper less than .0002-inch thick, sheet metal including steel and brass up to .040-inch thick, thin aluminum foil, textile yarn and roving, and coated textiles such as artificial leather.

Mac Two Pressure Air Valve

Featuring compactness of design, full orifice area, and simplicity of construction, a new air valve manufactured by Mechanical Air Controls, Inc., 3049 E. Grand Boulevard, Detroit 2, Mich., has the added feature of bringing economy in the operation of a double-acting cylinder. The "Mac" 4-way 5-part (two pressure) solenoid-operated air valve has two inlet ports which allow full line pressure to be applied to the stroke of an air cylinder. This causes a much lower pressure to be applied to the return stroke, thus effecting a real saving in compressed air.

High or low pressure can be applied to either inlet port, and pressures can be reversed at the option of the operator. Pressure range is from 20 to 150 psi and the valve is available in ⅜ and ¾-inch pipe sizes. "Mac" patented O-ring type seals give the "sealed with air pressure" feature of the poppet type valve, and yet maintain the ease of operation of the direct solenoid balanced type valve. The assembly consists of an iron base, bronze body with retainers, solenoid with cover, and the chromed aluminum piston, which is the only moving part. All wearing surfaces are hard chromed to assure long life.

"Sunny South"
"American"

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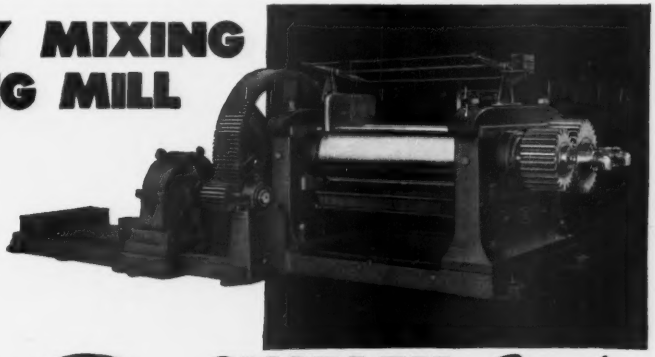
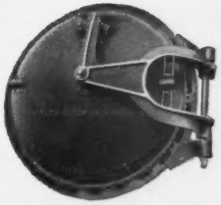
HEAVY DUTY MIXING *and* WARMING MILL



THIS NE 22"x 22"x 60" Heavy-duty Mill is streamlined for cleanliness. Heavy cast steel frames—journal housings designed for flood lubrication. Rolls are of high grade chilled iron—ground finish. All gears are machine cut from special cast steel. For Washer Service corrugated rolls are furnished. Consult with NE engineers.



SIMPLEX *Quick-Opening* DOORS

Consult NE for data on applications of Simplex Quick-opening doors in all sizes—60" illustrated.

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We are prepared to finish your own cotton piece goods or to furnish complete processed liners if you so desire.

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REVIEWS

BOOKS

The Physics of Rubber Elasticity. By L. R. G. Treloar. Published in England. Available from Oxford University Press, 114 Fifth Ave., New York 11, N. Y. 5½ x 8½ in. 256 pp. $6.00.

This is the fourth volume in a new series entitled "Monographs on the Physics and Chemistry of Materials." The series is intended to summarize the recent results of academic or long-range research in materials and allied subjects, in a form that should be useful to physicists in universities and in government and industrial laboratories.

As indicated by its title, the present volume covers the physics of rubber elasticity which has developed in both its theoretical and experimental aspects in a remarkable manner during recent years. Dr. Treloar, the author, a member of the staff of the British Rubber Producers' Research Association, has spent the past several years on research devoted to the fundamentals of rubber technology and is well qualified to discuss the subject of rubber elasticity.

Dr. Treloar sets down in concise form the essential lines of recent advances in both theoretical and experimental aspects of rubber elasticity. The statistical or kinetic theory of elasticity is developed *ab initio*, and is shown to give a satisfactory account of the fundamental mechanical and photo-elastic properties of rubber. The book also includes a discussion of the phenomena of crystallization, stress relaxation and flow, the dynamic properties of rubber, and the solution of engineering problems involving large elastic deformations.

The book has 13 chapters in all, a five-page bibliography, and cross-referenced author and subject indexes. It is well illustrated.

•

Standards on Textile Materials. Published by the American Society for Testing Materials, 1916 Race St., Philadelphia 3, Penna. 6 x 9 in. 586 pp. $4.50.

This edition includes in their latest form 84 specifications, test methods and tolerances developed by A.S.T.M. Committee D-13 on Textile Materials, as well as considerable other related material. Of the standards, 23 cover cotton, 9 rayon and silk, 11 wool, 7 asbestos, 6 glass, and 5 come under the heading of bast and leaf fibers. The balance of the standards are general testing methods, etc., covering testing machines, fire-retardant properties, air permeability of fabrics, interlaboratory testing, etc. Also included are a psychometric table for relative humidity, photomicrographs of common textile fibers and of defects in woven fabrics, a convenient yarn number conversion table, a glossary of textile terms, and terms relating to hand of fabrics. There are also convenient tables of contents (by subject and by A.S.T.M. designation) and an index of methods of tests.

•

Annual Report on the Progress of Rubber Technology: 1948. Edited by T. J. Drakeley. Published by W. Heffer & Sons, Ltd., Cambridge, England, for the Institution of the Rubber Industry, 12 Whitehall, London, S.W. 1, England. 7¼ x 9¾ in. 108 pp. Price to Members, 4/6 net; Non-Members, 12/6 net.

The latest edition of these specially-compiled annual reports covers the technical rubber literature, including patents, for the year of 1948. The same general format of previous editions has been followed, namely, various subjects are covered by leading technologists, all specialists in their respective fields, with extensive bibliographies appended to each chapter. There are twenty-two sections in all, embracing practically every branch of the rubber industry, together with the usual well-handled and cross-referenced author and subject indexes.

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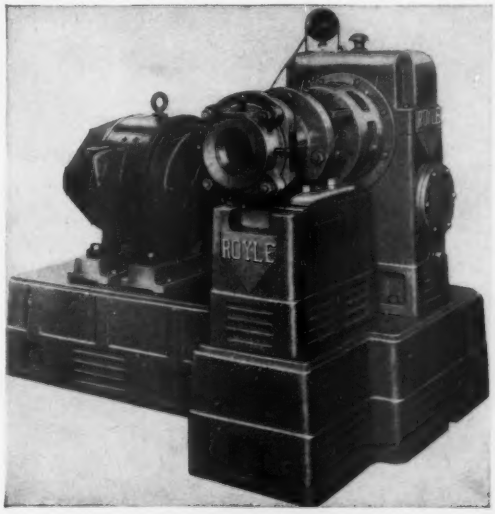

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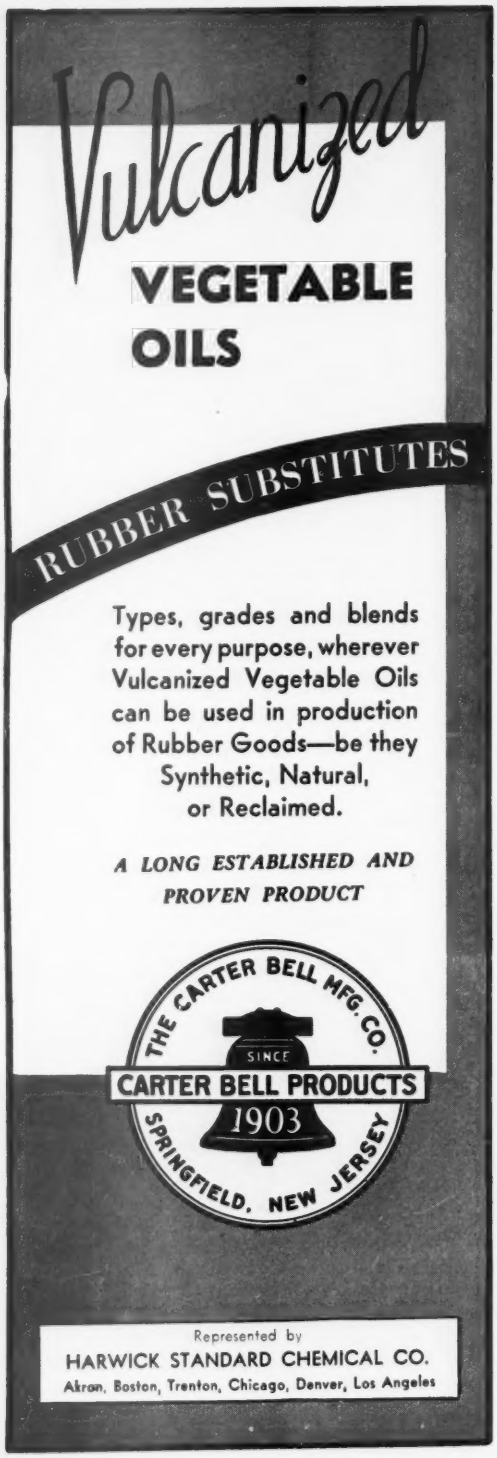
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Rubber's Home Town. By Hugh Allen. Published by Stratford House, Inc., 52 Vanderbilt Ave., New York 17, N. Y. 5½ x 8¼ in. 266 pp. $3.75.

This is the fifth volume of the American Heritage Series—the story of selected cities of America—being published by Stratford House, the purpose of which is to present to the citizens of these communities and to the people of America a re-discovery of the grass-root beginnings of our American heritage. As every rubber man will know, it is the story of Akron.

Few men could write the story as well as Hugh Allen who has been a part of Akron for some three decades, as newspaper editor, commentator, and member of the public relations staff of the Goodyear organization. Although it is the story of industry and how industry made the town, it is more a story of the people behind that industry. Among these people were Ferdinand Schumacher, founder of the Quaker Oats Co., and the fabulous Ohio Columbus Barber, the first match king.

Any story of Akron is bound to be a partial history of the American rubber industry and so it was inevitable that names like Dr. Benjamin Franklin Goodrich, Harvey Firestone, Paul Litchfield, Frank Seiberling, John Collyer and William O'Neil should be found occupying prominent position. In fact, about half of the book is devoted to these men, and others like them, and their rubber empires they built. In addition to its literary value, the book is a welcome addition to the historical literature on rubber.

•

Annotated Comprehensive List of Trade Names of Synthetics. Compiled by T. R. Dawson and M. J. Thomsett. Issued by the Research Association of British Rubber Manufacturers, 105-7 Lansdowne Road, Croydon, England. 8 x 13 in. 230 pp. Mimeographed. $10.00.

The troublesome problem of trade names which faces the entire chemical industry, including the rubber and plastics fields, will be considerably eased by this comprehensive collection of some 8,000 entries which represents a search of every journal, book and trade name list in the large R.A.B.R.M. library of rubber and plastic literature from June 30, 1926, through July 31, 1949. The work comprises a single alphabetical list of substitutes and extenders for natural rubber, synthetic rubbers, and synthetic resins and plastics, with the compilers giving a broad interpretation to those terms. Wherever possible, the nature or chemical composition and the form in which the synthetic is available are given in addition to the name and address of the manufacturer or distributor. Names included are not only registered trade marks, but also commercial and technological terms such as rayon, nylon and neoprene. The R.A.B.R.M. is to be congratulated for undertaking this valuable compilation.

•

Titanium: Its Occurrence, Chemistry and Technology. By Jelks Barksdale. Published by the Ronald Press Co., 15 East 26th St., New York 10, N. Y. 6¼ x 9¼ in. 592 pp. $10.00.

This book meets the growing need for a comprehensive working reference volume on titanium. As indicated by its sub-title, the book covers the occurrence, chemistry and technology of titanium and brings together in one volume considerable data available heretofore only in separate journals and the extensive patent literature. Several chapters are devoted to specific applications of the titanium pigments, including those in rubber and plastics, and if any criticism can be levelled against the book it is that it is unfortunate that these chapters were not considerably expanded. The section on rubber, for example, covers two short pages only, and that on plastics one page only. Titanium pigments are certainly important enough in the rubber industry to have merited longer treatment. The book has 28 chapters and a cross-referenced subject index. An extensive bibliography is also included.

BOOKLETS, CATALOGS, etc.

Mikro Processing Equipment. Pulverizing Machinery Co., Chatham Road, Summit, N. J. 8½ x 11 in. 50 pp.

Bound in handy loose-leaf style, this book contains a complete description of the various types of Mikro-Pulverizers for precise particle control on a wide range of applications. A three-page list of materials to which the equipment is applicable supplements this section of the book. Another part of the book is devoted to the Mikro-Atomizer, which is designed for ultra-fine grinds in the lower micron ranges. The Mikro-Collector, for the separation of solids from dust-laden air, is also pictured and described in some detail. Featured in another part of the book is the Mikro plan for processing efficiency, in which is outlined the engineering, laboratory analysis, test grinding, and after installation service, which are features of the company's service. Proper equipment for laboratory and pilot plant pulverizing operations preparatory to production runs is also shown and described in some detail.

•

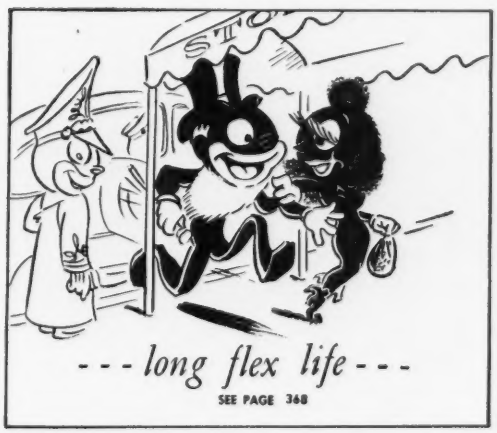
Air Operated Arbor Presses. (Bulletin No. 250). Hannifin Corp., 1151 South Kilbourn Avenue, Chicago 24, Ill. 8½ x 11 in. 4 pp.

Information on the design, dimensions and capacities of Hannifin Air Operated Arbor Presses is provided in this bulletin. Control valves which are utilized to operate these presses are also described including hand control, foot control and electronic control models. Pressure regulators, lubricators and filters are also discussed. Dimensional drawings illustrate the Hannifin Lever Type Air Presses. Capacities, purposes and modifications of the presses are fully covered.

•

Dravo Counterflo Warm Air Space Heaters. (Bulletin No. 520). Heating Section, Machinery Division, Dravo Corp., Dravo Building, Pittsburgh 22, Penna. 8½ x 11 in. 6 pp.

Mechanical ventilation of industrial structures to remove air contaminated by fumes, dust or gases, and its replacement with fresh air is described in this brochure. A typical installation utilizing the Dravo system, in this case a large foundry, is outlined as to operation, placement and results. The brochure is illustrated with photographs and cutaway drawings which outline the mechanics of operation of Dravo heating units.



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Plastic Scrap

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LONDON

THE RUBBER INDUSTRY owes its development largely to scientific and technical research and the Institution was founded in 1921 to foster scientific and technical advancement and to disseminate the results.

THE INSTITUTION TODAY is the centre of a great fraternity of rubber manufacturers, scientists, technologists, research establishments, executives and students from every country whose object is the advancement of the cause of the rubber industry throughout the world.

OBJECTS: To promote corporate and concerted effort in the industry by bringing together all those engaged or interested in the various branches of science and technology on which the Industry is based and co-ordinating their respective contributions.

To promote the profession and practice of Rubber Technology.

To encourage the extension of scientific and technical education in the principles and details of rubber manufacture.

To maintain a scheme of Diplomas for the recognition of efficiency in knowledge of all branches of technology essential to the successful maintenance and development of rubber manufacture.

To arrange for the holding of meetings, the reading of papers and the giving of lectures with subsequent discussions and publications.

To foster the systematic study of scientific and technical problems involved in the various phases of the manufacture of natural and synthetic rubbers and rubber-like materials and their conversion into finished products.

To encourage original work and research dealing with the manufacture of rubbers.

PUBLICATIONS.

The Transactions: Bi-monthly record of scientific and technological investigations in the realm of rubber and its allied industries.

Annual Report on the Progress of Rubber Technology: containing systematic accounts of the developments in rubber technology from year to year.

Proceedings of Rubber Technology Conferences.

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INSTITUTION OF THE RUBBER INDUSTRY
12, WHITEHALL
LONDON, S.W. 1, ENGLAND

REVIEWS (CONT'D)

The Master of Flame: Dry Chemical Fire Extinguishing Equipment. Fire Extinguisher Division, Ansul Chemical Co., Marinette, Wisc. 8½ x 11 in. 20 pp.

Important features and specifications of the company's line of dry chemical fire extinguishing equipment are presented in this booklet. Hand, stationary and wheeled equipment are described as are Ansul fire trucks and special types of fire fighting equipment. Different tables compare the characteristics of approved hand fire extinguishers and the comparative effectiveness of approved fire extinguishers. Other topics discussed include piped systems and accessories. Complete specifications, cutaway views and other pertinent information and photographs add to the effectiveness of the booklet.

•

Bassick "V" Grooved Wheel Casters for Angle Iron Track. Bassick Co., Bridgeport, Conn. 8½ x 11 in. 8 pp.

Latest information on "V" grooved wheel casters for angle iron track is presented in this folder. Cross-sectional designs illustrate corner turns, turn-and-cross-over, and single and double switch installations of the track. Other information presented includes catalog listings and photographs of the complete line of company casters. Another section of photographs shows the casters as they are used in industry.

•

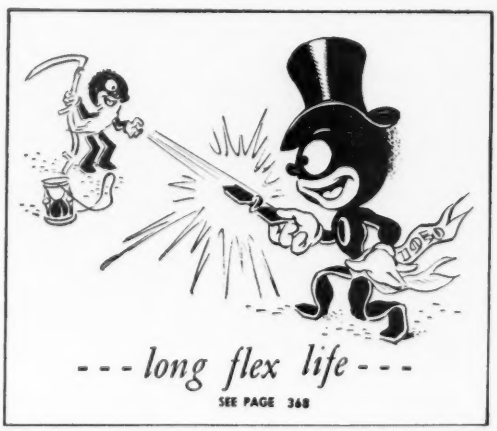
The Story of the Chemicals You Live By. Diamond Alkali Co., 300 Union Commerce Building, Cleveland 14, Ohio. 5 x 8 in., 16 pp.

Eight major groups of chemical products and their diverse utilization throughout American industry are described in this booklet. Written in simple, non-technical terms and attractively illustrated, this booklet reviews soda ash, chlorine, bicarbonate of soda, silicates, calcium carbonates, chromates, and specialty chemicals, pointing up the economic significance of each group.

•

Centrifugal Chemical Pumps (Bulletin W-350-B-11). Worthington Pump and Machinery Corp., Harrison, N. J. 8½ x 11 in. 12 pp.

This bulletin describes and illustrates some of Worthington's centrifugal pumping equipment used in the chemical process industries. It gives a complete explanation of the Worthington Mechanical Seal designed to prevent leakage of corrosive liquids, and describes Worthite, the company's corrosion resistant metal.



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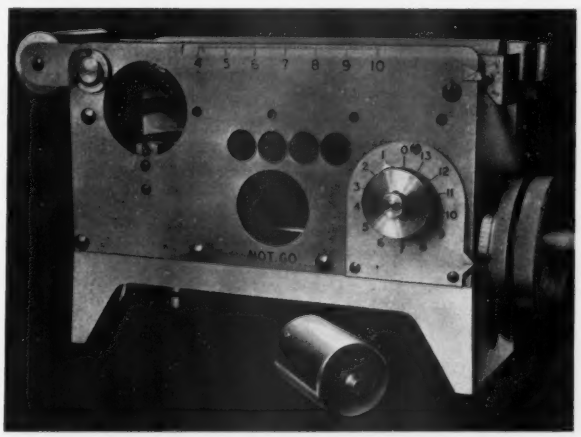

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Catalogue on Application

MARKETS

Rubber – Crude, Reclaimed and Scrap – Cotton – Ducks – Tire Fabrics – Sheetings

NEW YORK, JAN. 5, 1950

Natural Rubber

The price of spot rubber on the Commodity Exchange has swung in a range of 126 points since our last report (December 7), high for the period being 18.38 cents reached on January 5, and low being 17.12 cents reached on December 22. The average price of spot rubber for the month of December was 17.53 cents based on 21 trading days. This compares with an average of 16.70 cents for the month of November.

Extreme optimistic estimates on rubber consumption in the first quarter of this year and the apparent strong statistical position of natural rubber tends to keep sentiment rather friendly to maintained or even higher prices. It may be too early to gauge the effect of higher natural rubber prices on the U. S. consumer. However, some smaller manufacturers that have been using natural are now increasing the use of synthetic.

Malayan rubber production in 1949 is expected to be about 662,000 tons or some 36,000 tons below the all-time record output of 1948 when a total of 698,200 tons was produced. Indonesian production in 1949 did not exceed 420,000 tons which is some 80,000 tons lower than the estimate made by the Rubber Study Group.

Trade sources are of the opinion that for the next two or three months the natural rubber supply picture may remain relatively tight, depending on the extent of world demand. Beyond that time, a more difficult position may present itself.

Today's quotations on the outside market, London and Singapore, follow:

Outside Market

No. 1 Ribbed Smoked Sheets:	
Spot	.18½
February	.18⅜
April-June	.18⅜
Thin Latex Crepe:	
Spot	.24¼
January	.24¼
Thin Brown Crepe, No. 2	.17¾
Ambers, No. 3	.17¾
Flat Bark Crepe	.16¾

London Market

(Standard Smoked Sheets)

March	17.57 — 17.65
April-June	17.50 — 17.57

Singapore Market

(Standard Smoked Sheets)

January	16.55 — 16.59

Synthetic Rubber

(Dry Types-Per Pound)

Butaprene NF	.440 - .450
Butaprene NL	.450 - .460
Butaprene NAA	.490 - .500
Butaprene NXM	.520 - .530
Chemigum 30 N4NS	.400 - .470
Chemigum 50N4NS	.400 - .470
Chemigum N3	.450 - .520
GR-I	—— - .185
GR-S	—— - .185
Hycar OR-25	.450 - .460
Hycar OR-15	.520 - .530
Hycar OS-10	.500 - .510
Neoprene Types CG and AC	—— - .500
Neoprene Type E	—— - .650
Neoprene Types FR and KNR	—— - .750
Neoprene Type GN	—— - .320
Neoprene Type GN-A	—— - .320
Neoprene Type RT	—— - .350
Neoprene Type S	—— - .320
Neoprene Type W	—— - .350
Paracril 18	.430 - .450
Paracril 26	.440 - .460
Paracril 35	.510 - .530
Silastic (compounded)	2.35 - 4.40
Thiokol Type A	.370 - .470
Thiokol Type FA	.520 - .620
Thiokol PR-1	.750 - .850
Thiokol Type ST	.750 - .850

Scrap Rubber

The movement of scrap rubber during December continued at a fairly steady pace, continuing an improvement shown during the past few months. It has been estimated that business in the first quarter of 1950 will maintain the upward turn manifested in the last quarter of 1949. Prices for scrap rubber have not changed to any great degree. Current quotations follow:

Mixed passenger tires	ton	$13.00
Beadless truck tires	ton	nom.
Mixed truck tires	ton	15.00
Beadless passenger tires	ton	nom.
No. 1 passenger peelings	ton	42.50
No. 1 truck peelings	ton	42.50
Red passenger tubes	lb.	.07
Black passenger tubes	lb.	.04
Mixed passenger tubes	lb.	.04
No. 2 truck tubes	lb.	nom.
Red truck tubes	lb.	.07
Black truck tubes	lb.	.03¾
Buffings	ton	15.00

Reclaimed Rubber

Consumption of reclaim for the month of November is estimated at 18,426 long tons by the Department of Commerce. This compares with a consumption of 19,638 long tons for the month of October. Trade sources indicate that the reclaim business was fairly good during the past year. A brisk demand is expected for the first quarter of 1950 if automobile factories operate at capacity as planned. Higher crude rubber prices will also tend to stimulate the demand for reclaim. Prices remain at substantially the same levels. Current quotations follow:

Tires

Black, Digester (Natural)	lb.	.08¾ - .08¾
Peels No. 1	lb.	.08¼ - .08¾
Whole Tire (Blend)	lb.	.08¾ - .08¾

Inner Tubes

Black (Natural)	lb.	.11½ - .12
Red (Natural)	lb.	.13½ - .14½
Butyl	lb.	.08¼ - .08¾

Shoe

Unwashed (Natural)	lb.	.08¾ - .09¼

Cotton Tire Fabrics

The cotton tire fabric market for 1949 maintained a generally low position. Observable trends for the first quarter of 1950 do not indicate an appreciable improvement in market conditions. The general lethargy of the market is attributed to many factors including the fact that many tire manufacturers have shifted from the use of cotton fabrics to rayon and nylon cords. Prices have not been adjusted during the past period. Current quotations follow:

Standard, Peeler, 12/4/2	lb.	.68
Standard, Peeler, 14/4/2	lb.	.70
Standard, Peeler, 16/4/3	lb.	.7250
Extra Staple, Peeler, 12/4/2	lb.	.8315
Extra Staple, Peeler, 14/4/2	lb.	.8575
Extra Staple, Peeler, 16/4/3	lb.	.8825

Chafers

14.4 oz. (per sq. yard)	lb.	.67
9.25 oz. (per sq. yard)	lb.	.6325
11.65 oz. (per sq. yard)	lb.	.60
8.9 oz. (per sq. yard)	lb.	.6475

Cotton

The price of middling uplands on the Cotton Exchange has swung in a range of 86 points since our last report (December 7), high for the period being 31.68 cents reached on January 5, and low being 30.82 cents reached on December 8. The average price of middling uplands for the month of December was 31.08 cents based on 24 trading days. This compares with an average of 30.52 cents for November.

Representative Harold Cooley (D., N. C.), chairman of the House Agriculture Committee, has indicated he will call the committee together to consider legislation removing alleged "inequities" from current cotton acreage allotment law. The Cooley measure would provide minimum allotments for 1950 of not less than 70% of a farmer's average planted acreage in 1946, 1947 and 1948, or not less than 50% of the highest amount planted to cotton in any of those three years.

As far as exports are concerned, the recent 25% cut in ECA funds will cut about 620,000 bales from current expenditures which involved an estimated 2,500,000 bales.

The Commodity Credit Corporation has reported that loans through December 29 totaled 2,387,359 bales. Repossessions since August 1 totaled 52,390 bales, for a weekly average of 9,982 bales.

China is expected to ask for cotton credits as soon as the new government becomes stabilized. It is said that Japan could use 1,000,000 bales of cotton during the coming year, of which 800,000 bales are expected to come from the United States.

Quotations for middling uplands on the Exchange follow:

	Dec. 7	January 5		
	Close	High	Low	Close
March	30.35	30.88	30.71	30.88
May	30.23	30.81	30.57	30.81
July	29.71	30.35	30.05	30.34

Closing Rubber Prices on New York Commodity Exchange

(No. 1 R.S.S. Contract)

FROM DECEMBER 8 TO JANUARY 5

Dec.	Spot	Dec.	Mar.	May	July	Sales
8	17.62	17.36	17.25	17.20	17.00	104
9	17.50	17.70	17.52	17.45	17.15	76
10	——	——	——	——	——	——
11	——	——	——	——	——	——
12	17.62	17.65	17.65	17.44	17.20	74
13	17.75	17.50	17.50	17.35	17.00	166
14	17.56	17.50	17.45	17.26	16.92	218
15	17.50	17.41	17.36	17.20	16.93	50
16	17.50	17.25	17.20	17.07	16.83	138
17	——	——	——	——	——	——
18	——	——	——	——	——	——
19	17.38	17.60	17.75	17.55	17.30	140
20	17.75	17.50	17.63	17.44	17.15	34
21	17.62	17.85	17.88	17.70	17.37	252
22	17.12	17.70	17.78	17.55	17.26	35
23	17.68	17.70	17.75	17.55	17.19	40
24	——	——	——	——	——	——
25	——	——	——	——	——	——
26	——	——	——	——	——	——
27	17.75	17.84	17.85	17.65	17.25	47
28	18.00	18.10	18.02	17.75	17.30	47
29	18.00	——	17.98	17.75	17.20	42
30	18.00	——	18.05	17.80	17.30	74
31	——	——	——	——	——	——
Jan.						
1	——	——	——	——	——	——
2	——	——	——	——	——	——
3	18.06	——	18.27	17.95	17.55	71
4	18.25	——	18.33	18.00	17.60	231
5	18.38	——	18.50	18.13	17.70	99

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STATISTICS *Of Interest to the Rubber Industry*

U. S. Imports and Re-Exports of Natural Rubber

	GROSS IMPORTS											
	Natural Rubber (Dry)			Natural Rubber (Latex)			Guayule				RE-EXPORTS		TOTAL NET IM-PORTS
Year	Long Tons	Total Declared Value	Average Declared Value per pound Cents	Long Tons	Total Declared Value	Average Declared Value per pound Cents	Long Tons	Total Declared Value	Average Declared Value per pound Cents	Total Gross Imports Long Tons	Long Tons	Total Declared Value	Long Tons
1936	**467,064**	**152,072,496**	**14.54**	**19,852**	**6,659,899**	**14.98**	**1,229**	**286,552**	**10.41**	**488,145**	**12,581**	**4,488,223**	**475,564**
1937	**574,600**	**237,307,041**	**18.44**	**23,185**	**10,213,670**	**19.67**	**2,694**	**745,873**	**12.36**	**600,479**	**7,902**	**3,885,433**	**592,577**
1938	**397,620**	**125,357,730**	**14.07**	**11,878**	**4,147,318**	**15.59**	**2,485**	**623,819**	**11.21**	**411,983**	**5,652**	**1,799,124**	**406,331**
1939	**469,803**	**167,558,245**	**15.92**	**27,438**	**10,467,552**	**17.03**	**2,232**	**463,345**	**9.27**	**499,473**	**13,125**	**5,832,618**	**486,348**
1940	**780,820**	**303,117,726**	**17.33**	**33,789**	**14,593,466**	**19.28**	**3,634**	**758,007**	**9.31**	**818,243**	**7,060**	**3,197,136**	**811,183**
1941	**989,329**	**401,890,393**	**18.14**	**34,798**	**15,965,627**	**20.48**	**4,881**	**1,145,767**	**10.48**	**1,029,008**	**5,376**	**2,757,872**	**1,023,632**
1942	**365,980**	**112,377,896**	**18.86**	**10,646**	**5,630,667**	**23.61**	**5,523**	**1,660,792**	**13.42**	**282,149**	**10,856**	**5,913,386**	**271,293**
1943	**50,348**	**31,364,033**	**27.81**	**1,890**	**1,312,202**	**30.99**	**7,679**	**3,636,789**	**21.14**	**59,917**	**22,587**	**16,446,707**	**37,330**
1944	**103,820**	**73,908,389**	**31.78**	**3,091**	**2,092,211**	**30.22**	**6,700**	**3,351,233**	**22.33**	**113,611**	**9,739**	**8,712,695**	**103,872**
1945	**134,454**	**95,850,441**	**31.82**	**4,773**	**3,115,853**	**29.14**	**10,040**	**5,963,797**	**26.52**	**149,267**	**9,509**	**7,201,746**	**139,758**
1946	366,415	222,552,939	27.12	8,421	5,843,085	30.98	5,344	2,859,246	23.89	380,180	7,711	5,331,954	372,469
1947	690,954	306,919,456	19.83	17,722	9,820,080	24.91	2,880	1,492,825	20.30	711,556	4,122	2,354,494	707,434
1948	702,293	290,849,177	18.49	32,762	18,288,223	24.92	302	71,330	10.53	735,357	6,672	3,259,324	728,685
1948:													
Mar.	68,848	27,902,550	18.09	3,148	1,730,014	24.02	25	6,845	10.05	72,021	467	215,156	71,554
Apr.	38,433	15,136,536	17.35	2,284	1,260,932	24.65	30	7,076	10.53	40,747	343	190,815	40,404
May	37,227	14,409,747	17.28	**3,442**	**1,915,744**	**24.84**	**40**	**9,435**	**10.53**	**40,709**	**1,031**	**485,941**	**39,678**
June	62,376	25,338,739	18.13	**2,288**	**1,335,173**	26.05	60	14,152	10.53	64,724	718	348,043	64,006
July	60,070	25,206,980	18.07	**3,654**	**2,002,902**	24.48	100	23,587	10.53	63,734	466	243,774	63,268
Aug.	65,736	26,975,557	18.33	**2,395**	**1,389,495**	25.81	....	.....	....	67,771	520	268,912	67,251
Sept.	49,119	21,480,244	19.52	**1,434**	**813,347**	25.24	....	.....	....	50,553	514	229,016	50,039
Oct.	58,300	26,161,356	20.03	**2,728**	**1,574,419**	25.83	....	.....	....	61,028	675	320,570	60,353
Nov.	**49,800**	**22,292,055**	**19.98**	**813**	**466,095**	**25.59**	....	.....	....	**50,613**	**772**	**349,315**	**49,841**
Dec.	83,419	35,495,327	19.00	4,216	2,366,959	24.75	....	.....	....	87,635	569	250,540	87,066
1949:													
Jan.	66,575	27,037,698	18.13	1,132	634,165	25.02	....	.....	....	67,707	757	320,036	66,950
Feb.	55,234	21,549,791	17.41	2,159	1,030,107	21.30	....	.....	....	57,393	434	211,323	56,959
Mar.	53,768	20,095,422	16.68	2,809	1,564,383	24.87	....	.....	....	56,577	562	245,780	56,015
Apr.	48,262	18,167,840	16.85	2,271	1,219,404	23.97	....	.....	....	50,533	315	165,632	50,218
May	51,243	18,827,018	16.40	2,191	1,105,887	22.54	....	.....	....	53,434	390	181,457	53,044
June	49,038	18,084,566	16.47	2,180	1,113,169	22.80	....	.....	....	51,218	471	226,882	50,747
July	43,474	15,502,688	15.76	2,267	1,146,784	22.59	....	.....	....	45,741	699	289,896	45,042
Aug.	46,853	15,828,526	15.08	2,725	1,342,109	21.98	....	.....	....	49,578	251	110,368	49,327
Sept.	43,476	14,069,331	14.45	2,144	1,095,225	22.81	....	.....	....	45,620	556	248,921	45,064
Oct.	44,651	14,678,475	14.66	2,634	1,213,360	20.57	....	.....	....	47,285	404	160,047	46,881

Source: U. S. Department of Commerce.
Notes: (1) Figures for latex are on a dry weight basis. (2) Figures for re-exports include natural rubber (dry and latex) and guayule.

Natural Rubber
(Including Latex and Guayule)

(All Quantities in Long Tons)

Year	New Supply	Consumption	Re-Exports	Stocks On Hand at End of Period
1936	**488,145**	**575,000**	**12,581**	**223,000**
1937	**600,479**	**543,600**	**7,902**	**262,204**
1938	**411,983**	**437,031**	**5,652**	**231,500**
1939	**499,473**	**592,000**	**13,125**	**125,800**
1940	**818,243**	**648,500**	**7,060**	**288,864**
1941	**1,029,007**	**775,000**	**5,376**	**533,344**
1942	**282,653**	**376,791**	**10,856**	**422,714**
1943	**55,329**	**317,634**	**20,815**	**139,594**
1944	**107,834**	**144,113**	**9,665**	**93,650**
1945	**135,672**	**108,429**	**6,743**	**118,715**
1946	**400,687**	**277,597**	**4,338**	**237,467**
1947	688,354	562,661	4,101	129,038
1948	735,227	627,332	6,673	141,541
1948:				
Jan.	80,564	58,174	334	136,227
Feb.	54,418	51,012	290	140,081
Mar.	72,070	54,444	467	130,295
Apr.	40,947	50,616	343	123,248
May	40,709	**52,022**	**1,031**	**112,724**
June	64,725	55,701	718	**119,818**
July	**63,775**	**48,769**	**466**	**128,446**
Aug.	68,131	53,366	520	129,622
Sept.	50,556	52,131	514	123,912
Oct.	61,027	49,617	675	118,187
Nov.	**50,671**	**51,632**	**746**	**113,251**
Dec.	87,634	45,985	569	141,541
1949:				
Jan.	67,706	50,188	757	125,050
Feb.	57,401	46,285	434	118,803
Mar.	56,577	**53,108**	562	117,664
Apr.	50,533	47,859	315	112,916
May	53,510	46,128	390	111,875
June	51,218	47,117	471	103,626
July	46,277	40,597	699	103,017
Aug.	49,579	45,307	251	99,850
Sept.	45,620	43,978	556	100,618
Oct.	47,285	51,243	404	90,733
Nov.	65,433	51,785	500	98,246

Source: 1936-40, U. S. Department of Commerce; 1941 to date, Rubber Division, OMD, and Predecessor Agencies.

U.S. Gross Imports of Balata, Jelutong, Gutta-Percha, etc.

(All Quantities in Long Tons)

	Balata		Jelutong		Gutta-Percha & Other Guttas	
Year	Tons	Value	Tons	Value	Tons	Value
1936	535	199,368	6,163	1,296,364	1,568	555,643
1937	354	151,344	7,109	2,017,786	1,122	440,894
1938	509	181,140	9,132	2,944,504	444	204,582
1939	694	265,553	6,640	1,603,418	1,740	539,255
1940	648	300,500	7,451	2,449,137	2,340	1,004,885
1941	924	489,514	8,821	2,954,001	1,783	607,025
1942	1,544	1,107,059	1,200	530,296	804	525,763
1943	1,047	708,701	35	14,840	....	.....
1944	1,012	660,805	86	45,578	10	4,999
1945	1,361	907,253	....	.....	36	21,970
1946	2,281	2,233,065	304	256,169	423	458,064
1947	1,982	2,276,531	2,878	1,496,887	392	779,591
1948	1,195	805,078	3,401	2,377,765	423	542,788
1948:						
Feb.	145	90,023	307	209,015	66	84,839
Mar.	283	189,933	436	271,314	51	101,691
Apr.	82	36,570	651	393,280	52	68,366
May	45	36,109	512	314,432	24	54,191
June	67	36,885	277	211,373	45	41,277
July	120	87,327	205	170,949	15	35,001
Aug.	59	50,511	112	107,431	53	39,607
Sept.	91	67,970	112	83,432	0	0
Oct.	83	67,726	145	181,424	0	0
Nov.	86	49,155	48	36,634	20	10,572
Dec.	85	56,896	106	108,975	24	12,324
1949:						
Jan.	46	29,922	91	93,738	19	11,934
Feb.	65	53,665	77	91,362	9	16,328
Mar.	136	86,499	60	52,313	5	30,967
Apr.	88	48,244	14	8,753	16	9,878
May	103	60,361	85	83,291	....	.....
June	44	20,821	74	47,515	27	16,292
July	164	78,112	46	37,403	5	3,391
Aug.	137	66,002	114	96,509	5	2,218
Sept.	208	122,732	91	74,605	22	31,672
Oct.	222	142,538	123	92,681	19	15,221

Source: U. S. Department of Commerce.

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Synthetic Rubber—Totals

(GR-S, Neoprene, Butyl, and Buna N Types)

(All Quantities in Long Tons)

Year	Production	Imports	Consumption	Exports	Stocks On Hand at End of Period
1941	8,383	.....	6,259	572	1,702
1942	22,434	.....	17,651	1,419	4,612
1943	231,722	.....	170,891	18,148	41,568
1944	762,630	11,043	566,670	104,266	142,927
1945	820,373	10,407	693,580	83,778	203,454
1946	740,026	7,709	761,699*	72,920	114,963
1947	508,702	1,093	559,566	11,385	62,366
1948	488,343	15,671	442,072	4,874	115,111
1948:					
Nov.	40,779	1,988	37,690	366	107,297
Dec.	42,133	1,450	35,446	475	115,111
1949:					
Jan.	38,890	927	36,765	623	118,357
Feb.	36,103	1,170	34,611	335	118,932
Mar.	36,063	1,436	38,746	963	116,843
Apr.	35,445	881	36,454	506	114,944
May	32,335	1,402	35,267	619	112,739
June	31,953	1,127	36,949	513	106,813
July	34,270	1,689	30,014	614	113,595
Aug.	33,885	1,745	35,630	369	111,333
Sept.	30,878	2,086	32,443	415	110,848
Oct.	28,015	....	33,481	....	103,963

Source: Rubber Division, OMD, and Predecessor Agencies.
Notes: (1) These figures are revised from time to time and the latest available issue should be consulted for the most accurate data. (2) Figures shown include the output of both government and privately-owned plants. (3) Figures for 1941 are estimated. * Includes year-end adjustment of 5,384 tons to cover non-reporting companies.

Synthetic Rubber—By Type

(All Quantities in Long Tons)

New Supply

	GR-S (Buna S)	GR-M (Neoprene)	GR-I (Butyl)	Buna N Types	Total
1942	3,721	8,956	23	9,734	22,434
1943	182,259	33,603	1,373	14,487	231,722
1944	679,949	56,660	20,252	16,812	773,673
1945	724,859	45,672	52,378	7,871	830,780
1946	613,408	47,766	80,823	5,738	747,735
1947	408,858	31,495	62,824	6,618	509,795
1948	405,492	34,848	56,662	7,012	504,014

Consumption

1942	2,579	6,833	22	8,217	17,651
1943	131,977	26,205	304	12,405	170,891
1944	495,552	46,243	10,763	14,112	566,670
1945	600,145	42,394	43,012	8,029	693,580
1946	632,126	44,357	79,228	5,988	761,699
1947	448,589	37,703	68,838	4,536	559,666
1948	345,313	32,118	58,870	5,771	442,072

Exports

1942	222	1,037	..	160	1,419
1943	14,937	2,540	40	631	18,148
1944	98,380	4,799	530	557	104,266
1945	76,555	5,837	980	406	83,778
1946	68,763	2,642	495	797	72,697
1947	7,951	2,617	62	755	11,385
1948	1,093	2,875	21	885	4,874

Stocks at End of Period

1942	1,050	1,786	4	1,772	4,612
1943	30,975	6,415	1,033	3,145	41,568
1944	116,130	11,739	9,892	5,166	142,927
1945	170,571	9,703	18,378	4,802	203,454
1946	81,483	10,470	19,478	3,755	115,186
1947	40,606	5,237	13,184	3,339	62,366
1948	96,282	5,072	10,995	2,762	115,111

Source: Rubber Division, OMD, and Predecessor Agencies.
Notes: (1) These figures are revised from time to time and the latest available issue should be consulted for the most accurate data. (2) Figures for GR-M and Buna N Types include production of privately-owned plants.

Gasoline Consumption

(In Thousands of Barrels of 42 Gallons)

	1942	1943	1944	1945	1946	1947	1948	1949
Jan.	49,216	36,085	47,540	52,008	51,746	57,057	61,308	63,083
Feb.	42,666	36,274	47,754	48,856	47,654	50,551	56,487	57,934
Mar.	50,820	41,586	52,263	55,364	56,703	59,947	68,171	73,118
Apr.	49,554	48,177	50,005	59,024	62,111	64,140	72,183	75,279
May	53,212	49,828	54,230	60,748	66,800	70,865	77,186	81,622
June	50,077	53,325	54,266	60,580	63,247	71,329	78,044	83,338
July	54,606	49,867	55,119	66,170	60,076	73,441	81,428	82,118
Aug.	48,793	51,880	55,618	70,058	66,729	72,089	80,351	84,632
Sept.	50,093	49,707	56,318	64,529	62,268	71,384	76,159	80,760
Oct.	50,094	53,111	53,154	55,708	66,637	73,277	75,164	79,253
Nov.	50,729	50,703	54,967	53,543	61,345	64,158	72,560	.....
Dec.	39,250	48,695	52,250	49,745	61,101	67,506	72,162	.....
Total	589,110	568,238	633,482	696,333	735,417	795,015	871,200	.....

Source: U. S. Bureau of Mines.

Reclaimed Rubber

(Including Natural and Synthetic)

(All Quantities in Long Tons)

Year	Production	Consumption Tons	Consumption % to Crude [a]	Exports	Stocks On Hand at End of Period
1936	150,571	141,486	24.6	7,085	19,000
1937	185,033	162,000	29.8	13,233	28,800
1938	122,400	120,800	27.6	7,403	23,000
1939	186,000	170,000	28.7	12,611	25,250
1940	208,971	190,244	29.3	11,347	32,636
1941	274,202	251,231	32.2	13,851	41,750
1942	286,007[b]	254,820	64.6	30,405	42,532
1943	304,058[c]	291,082	59.6	15,678	46,201
1944	260,631[d]	251,083	35.3	11,800	43,832
1945	243,309	241,036	30.2	13,413	28,155
1946	295,612	275,410	26.5	14,461	33,666
1947	291,395	288,395	24.8	14,556	35,943
1948	266,861	261,113	24.4	11,428	32,630
1948:					
Sept.	21,805	23,478	25.7	740	30,198
Oct.	23,859	23,512	26.7	848	31,879
Nov.	23,050	22,170	24.8	1,210	33,378
Dec.	21,396	20,122	24.9	900	34,708
1949:					
Jan.	19,741	19,031	21.9	991	32,868
Feb.	18,270	17,712	21.9	1,012	32,738
Mar.	19,991	19,508	21.2	1,054	33,397
Apr.	18,463	18,649	22.1	1,070	32,825
May	18,184	18,323	22.5	887	32,326
June	18,849	19,316	23.0	694	30,684
July	14,626	15,966	22.6	681	29,126
Aug.	17,813	19,297	24.2	612	27,526
Sept.	18,304	18,517	24.2	761	26,257
Oct.	20,683	19,838	23.3	1,107	26,619
Nov.	19,363	18,426	22.2	800	27,885

Source: 1936-40, Department of Commerce; 1941 to date, Rubber Division, OMD, and Predecessor Agencies.
Notes: (1) These figures are revised from time to time and the latest available issue should be consulted for the most accurate data. [a] Includes natural and synthetic rubber. [b] Includes 893 tons of imports. [c] Includes 67 tons of imports. [d] Includes 21 tons of imports.

Automobile Production in U. S.

(Civilian Production Only)

Year	Passenger Cars	Trucks	Total	Year	Passenger Cars	Trucks	Total
1930	2,784,745	571,241	3,355,986				
1931	1,973,090	416,648	2,389,738	1940	3,692,328	721,637	4,413,965
1932	1,135,491	235,187	1,370,678	1941	3,744,500	875,381	4,619,681
1933	1,573,512	346,545	1,920,057	1942	220,814	133,083	353,897
1934	2,177,919	575,192	2,753,111	1943	0	4,501	4,501
1935	3,252,244	694,690	3,946,934	1944	0	124,819	124,819
1936	3,669,528	781,862	4,451,390	1945	83,792	313,643	397,435
1937	3,915,889	892,382	4,808,271	1946	2,148,699	930,760	3,079,459
1938	2,000,985	485,852	2,486,837	1947	3,558,178	1,220,634	4,778,812
1939	2,866,796	704,308	3,571,104	1948	3,909,270	1,363,856	5,273,126
1948:							
Jan.	305,081	99,200	404,281	July	356,764	116,780	473,544
Feb.	274,847	107,054	381,901	Aug.	348,782	111,760	460,542
Mar.	349,998	140,606	490,604	Sept.	301,170	111,224	412,394
Apr.	308,071	128,963	437,034	Oct.	383,756	107,352	491,108
May	225,461	111,789	337,250	Nov.	364,440	103,837	468,277
June	312,406	117,572	429,978	Dec.	378,455	107,702	486,157
1949:							
Jan.	326,019	104,599	430,618	July	483,261	95,348	578,609
Feb.	324,547	101,700	426,247	Aug.	557,370	99,850	657,220
Mar.	402,402	115,171	517,573	Sept.	534,493	91,389	625,882
Apr.	436,392	106,212	542,604	Oct.	.....	.....	.....
May	394,703	86,200	480,903	Nov.	.....	.....	.....
June	493,882	99,126	593,008	Dec.	.....	.....	.....

Source: Automobile Manufacturers Association.
Note: Figures are based on factory sales. Revisions are made from time to time in these figures and the latest issue should be consulted for accuracy.

Rim Production

	1944	1945	1946	1947	1948
Passenger Car	1,748,917	4,504,368	15,058,469	21,346,004	23,842,796
Truck & Bus	6,391,441	6,386,652	5,939,244	7,737,353	6,920,231
Agricultural	997,301	1,441,909	1,735,992	2,633,699	3,140,882
Earth Mover	703	1,308	5,520	10,610	13,330
Total	9,138,362	12,434,237	22,739,225	31,727,666	33,917,239

	1949					
	June	July	Aug.	Sept.	Oct.	Nov.
Passenger Car	2,660,576	2,260,020	3,023,981	3,014,872	2,478,051	1,332,637
Truck & Bus	293,872	344,984	310,351	293,933	268,408	189,423
Agricultural	216,695	154,913	233,734	207,691	194,837	135,976
Earth Mover	1,157	964	531	353	155	809
Total	3,172,300	2,760,881	3,568,597	3,516,849	2,941,451	1,658,845

Source: The Tire & Rim Association, Inc.

The right grade for high-grade rubber:

Wyandotte Ultra-fine Precipitated Calcium Carbonate

THIS highly refined chemical makes an excellent filler and reinforcing agent for rubber compounds.

It improves tensile and tear resistance . . . imparts excellent flex-life. It permits the production of finished articles of any desired color through the addition of that color to the milling formula. Rubber toys, sheeting, gloves and many other articles benefit from its use.

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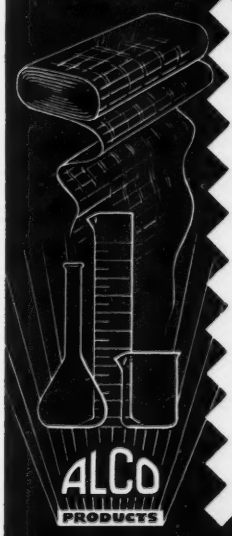

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AQUEOUS DISPERSIONS OF RUBBER CHEMICALS

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SOUTHERN DISTRIBUTORS
WICA COMPANY INC.
CHARLOTTE, N.C.

Automotive Pneumatic Casings

(Thousands of Units)

	Shipments: Original Equipment	Shipments: Replacement	Shipments: Export	Shipments: Total	Production	Inventory End of Period
1937 (total)	**22,353**	**29,886**	**1,246**	**53,485**	**53,310**	**10,383**
Passenger Car	20,055	26,177	696	46,928	46,497	8,745
Truck and Bus	2,298	3,709	550	6,557	6,813	1,638
1938 (total)	**11,516**	**30,567**	**1,049**	**43,132**	**40,907**	**8,451**
Passenger Car	10,086	27,104	580	37,770	35,789	6,937
Truck and Bus	1,430	3,463	469	5,362	5,118	1,514
1939 (total)	**18,208**	**38,022**	**1,279**	**57,509**	**57,613**	**8,665**
Passenger Car	15,742	33,471	607	49,820	49,933	7,108
Truck and Bus	2,466	4,551	672	7,689	7,680	1,557
1940 (total)	**22,252**	**35,346**	**1,176**	**58,774**	**59,186**	**9,127**
Passenger Car	19,560	30,903	411	50,874	50,965	7,270
Truck and Bus	2,692	4,443	765	7,900	8,221	1,857
1941 (total)	**24,780**	**39,895**	**1,489**	**66,164**	**61,540**	**4,436**
Passenger Car	19,855	34,119	586	54,560	50,392	3,165
Truck and Bus	4,925	5,776	903	11,604	11,148	1,271
1942 (total)	**6,680**	**8,872**	**207**	**15,759**	**15,351**	**6,247**
Passenger Car	910	2,734	38	3,682	2,790	4,432
Truck and Bus	5,770	6,138	169	12,077	12,561	1,815
1943 (total)	**6,128**	**18,547**	**225**	**24,900**	**20,423**	**1,883**
Passenger Car	82	10,606	71	10,759	7,620	1,132
Truck and Bus	6,046	7,941	154	14,141	12,803	751
1944 (total)	**6,654**	**26,439**	**263**	**33,356**	**33,446**	**2,013**
Passenger Car	208	18,330	130	18,668	18,819	1,218
Truck and Bus	6,446	8,109	133	14,688	14,627	795
1945 (total)	**5,984**	**36,479**	**504**	**42,967**	**44,524**	**3,077**
Passenger Car	1,115	25,463	222	26,800	28,200	2,214
Truck and Bus	4,869	11,016	282	16,167	16,324	863
1946 (total)	**15,310**	**65,490**	**1,512**	**82,312**	**82,298**	**2,448**
Passenger Car	11,086	54,684	653	66,423	66,466	1,763
Truck and Bus	4,224	10,806	859	15,889	15,832	685
1947 (total)	**25,056**	**62,871**	**3,256**	**91,183**	**95,550**	**6,949**
Passenger Car	19,644	52,857	1,608	74,109	77,795	5,444
Truck and Bus	5,412	10,014	1,648	17,074	17,755	1,505
1948 (total)	**26,845**	**49,148**	**1,787**	**77,781**	**81,314**	**10,698**
Passenger Car	21,589	41,295	656	63,540	66,738	8,773
Truck and Bus	5,256	7,853	1,132	14,241	14,576	1,925
1949:						
July (total)	3,098	4,488	108	7,694	6,264	11,717
Passenger Car	2,803	3,958	35	6,795	5,507	9,336
Truck and Bus	295	530	73	898	756	2,381
Aug. (total)	3,191	4,463	115	7,768	6,228	9,970
Passenger Car	2,933	3,807	40	6,780	5,538	7,926
Truck and Bus	258	655	75	988	690	2,044
Sept. (total)	3,056	3,576	114	6,746	5,604	8,936
Passenger Car	2,832	2,944	44	5,821	4,951	7,125
Truck and Bus	223	632	70	925	653	1,812
Oct. (total)	2,942	3,740	158	6,840	6,500	8,675
Passenger Car	2,712	3,005	68	5,785	5,621	7,016
Truck and Bus	230	735	90	1,055	879	1,659

Source: The Rubber Manufacturers Association, Inc.

Cotton, Rayon and Nylon Tire Fabrics

(Production in Thousands of Pounds)

	Cotton: Tire Cord Not Woven	Cotton: Cord Fabric Woven	Cotton: Chafer and All Other Tire Fabrics	Cotton: Total	Rayon and Nylon: Tire Cord Not Woven	Rayon and Nylon: Tire Cord And Other Tire Fabrics	Rayon and Nylon: Total
1946:							
Jan.-Mar.	**17,128**	**39,377**	**15,245**	**71,750**	*a*	**51,208**	**51,208**
Apr.-June	**19,622**	**40,197**	**18,623**	**78,442**	*a*	**52,511**	**52,511**
July-Sept.	**17,279**	**39,259**	**18,787**	**75,325**	**5,102**	**46,932**	**52,034**
Oct.-Dec.	**20,660**	**42,668**	**21,708**	**85,036**	**5,858**	**50,589**	**56,447**
Total	74,689	161,501	74,363	310,553	10,960	201,240	212,200
1947:							
Jan.-Mar.	**21,972**	**49,377**	**21,815**	**93,164**	**5,322**	**52,059**	**57,381**
Apr.-June	**23,491**	**53,746**	**16,480**	**93,717**	**5,486**	**47,360**	**52,846**
July-Sept.	**15,571**	**44,291**	**14,596**	**74,458**	**6,161**	**51,719**	**57,880**
Oct.-Dec.	**18,183**	**48,532**	**17,762**	**84,477**	**6,550**	**55,078**	**61,628**
Total	79,217	195,946	70,653	345,816	23,519	206,216	229,735
1948:							
Jan.-Mar.	**18,546**	**50,251**	**19,391**	**88,188**	*a*	**60,569**	**60,569**
Apr.-June	**15,585**	**45,385**	**18,213**	**79,183**	*a*	**59,759**	**59,759**
July-Sept.	29,743	45,927	*c*	75,670	*a*	63,642	63,642
Oct.-Dec.	13,321	34,424	15,879	63,624	*a*	65,258	65,258
Total	77,195	175,987	53,483	306,665	.....	249,228	249,228
1949:							
Jan.-Mar.	*d*	33,213	25,395	56,608	*a*	68,296	68,926
Apr.-June	5,309	29,114	13,617	48,040	*a*	68,269	68,269
July-Sept.	1,343	16,620	11,141	29,104	15,640	55,969	71,609
Oct.-Dec.	.....	.....	.....	.....	.....	.....	.....
Total	.....	.....	.....	.....	.....	.....	.....

Source: U. S. Bureau of the Census.

Notes: (a) Included with tire cord and fabrics to avoid disclosures of operations of individual mills. (b) Fuel cell fabrics are not included with rayon and nylon tire cord and fabrics. (c) Included with tire cord not woven. (d) Included with chafer and all other tire fabrics.

Automotive Inner Tubes

(Thousands of Units)

	Shipments: Original Equipment	Shipments: Replacement	Shipments: Export	Shipments: Total	Production	Inventory End of Period
1936	**21,514**	**32,188**	**721**	**54,423**	**57,036**	**10,945**
1937	**22,464**	**29,554**	**749**	**52,767**	**52,373**	**10,312**
1938	**11,515**	**28,134**	**644**	**40,293**	**37,848**	**8,166**
1939	**18,190**	**31,998**	**1,002**	**51,190**	**50,649**	**7,036**
1940	**22,172**	**29,070**	**972**	**52,214**	**52,237**	**7,817**
1941	**24,722**	**33,749**	**1,232**	**59,703**	**57,433**	**4,686**
1942	**6,895**	**7,213**	**159**	**14,267**	**12,685**	**6,206**
1943	**6,350**	**12,474**	**189**	**19,014**	**15,014**	**2,626**
1944	**6,460**	**20,569**	**196**	**27,224**	**27,488**	**2,813**
1945	**5,988**	**33,906**	**411**	**40,304**	**41,742**	**3,627**
1946	**15,327**	**59,357**	**1,434**	**76,108**	**77,251**	**3,820**
1947	**25,046**	**46,560**	**2,483**	**74,088**	**79,181**	**8,059**
1948	**26,839**	**40,494**	**1,125**	**68,457**	**70,150**	**9,734**
1949:						
Mar.	2,513	2,565	95	5,174	5,948	11,231
Apr.	2,767	2,552	78	5,396	6,059	11,748
May	2,380	2,830	87	5,296	6,088	12,410
June	3,231	3,106	72	6,409	6,430	12,466
July	3,107	3,127	64	6,230	5,230	11,364
Aug.	3,190	3,351	61	6,603	5,169	9,858
Sept.	3,007	2,766	69	5,483	4,902	8,916
Oct.	2,940	2,538	79	5,557	5,296	8,644

Source: The Rubber Manufacturers Association, Inc.

Smoked Sheets–Spot Closing Prices

(New York Market—Cents per pound)

Year	High	Low	Avg.	Year	High	Low	Avg.
1910	288	141	206.60	1930	16½	7½	11.98
1911	184	114	141.30	1931	8⅝	4¼	6.17
1912	140	108	121.60	1932	4¾	2½	3.49
1913	113	89	82.04	1933	9¼	2¾	5.96
1914	93	56	65.33	1934	15⅞	8¼	12.92
1915	79	58½	65.85	1935	13¼	10½	12.37
1916	102	55	72.50	1936	23	13½	16.41
1917	90	52	72.23	1937	26⅜	14	19.39
1918	70	40	60.15	1938	17⅜	10¼	14.64
1919	57	38½	48.70	1939	24	14⅜	17.57
1920	56½	16	36.30	1940	24	18¼	20.10
1921	21¼	11½	16.36	1941	24¾	19¼	22.40
1922	28⅜	13⅜	17.50	1942	22½	22½	22.50
1923	37½	24¾	29.45	1943	22½	22½	22.50
1924	40½	17⅜	26.20	1944	22½	22½	22.50
1925	121	34⅜	72.46	1945	22½	22½	22.50
1926	88⅝	36¾	48.50	1946	22¼	22½	22.50
1927	41¾	33	37.72	1947	25	14	20.00
1928	41¼	17	22.48	1948	25	18	21.99
1929	26⅞	15½	20.55	1949	19¾	15⅞	17.57

Note: Price was fixed by Government on August 6, 1941, at 22½c a pound for non-war uses. Free trading was resumed May 1, 1947.

Spot Closing Cotton Prices

(Middling Upland Grade—New York Market—in Cents)

Average Monthly Price Per Pound

	1942	1943	1944	1945	1946	1947	1948	1949
Jan.	**19.85**	**21.34**	**20.76**	**22.36**	**25.49**	**32.58**	**36.09**	**33.37**
Feb.	**20.05**	**21.61**	**21.34**	**22.29**	**26.57**	**33.91**	33.63	33.41
Mar.	20.42	21.98	21.65	22.43	27.52	35.89	35.04	33.44
Apr.	21.10	22.02	21.71	21.88	**28.40**	**35.89**	**38.10**	**33.84**
May	20.88	21.97	21.63	23.30	28.17	36.51	38.57	33.73
June	19.78	21.92	23.31	23.42	29.89	37.83	38.12	33.56
July	20.27	21.46	22.33	23.27	34.11	38.03	34.89	32.99
Aug.	19.45	21.09	22.11	23.10	36.31	34.83	32.23	32.06
Sept.	19.62	21.10	22.10	23.25	37.59	32.21	31.92	30.94
Oct.	19.79	21.00	22.32	23.85	36.79	32.39	32.01	30.32
Nov.	20.21	20.32	22.13	24.71	31.50	34.50	32.15	30.52
Dec.	20.55	20.32	22.28	25.21	33.03	36.74	32.90	31.08
Average for Year	20.16	21.34	21.89	23.25	31.28	35.11	34.64	32.44

Consumption of Vinyl Resins

(In Thousands of Pounds)

	Sheeting and Film [a]	Textile and Paper Coating Resins [b]	Molding and Extrusion Materials [b]	All Other [b, c]
1946	**52,080**	**11,673**	**61,852**	**27,083**
1947	**66,430**	**17,237**	**73,114**	**27,864**
1948	98,021	31,085	73,598	21,147
1949:				
Jan.	10,197	2,847	6,834	2,589
Feb.	9,368	1,979	5,569	2,148
Mar.	11,787	2,384	5,660	2,387
Apr.	13,600	2,489	4,775	1,694
May	10,986	2,212	4,817	1,406
June	10,827	2,177	5,592	1,136
July	10,020	1,901	5,560	994
Aug.	12,849	2,125	6,330	816
Sept.	15,818	2,632	7,807	1,718

Source: Bureau of the Census.

Notes: (a) Includes weight of fillers, plasticizers, extenders and safety glass sheeting; (b) Resin content; (c) Includes Adhesives, but excludes data for protective coating resins.

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Makers of Stamford "Factice" Vulcanized Oil Since 1900

Rubber Industry Employment, Wages and Hours

All Rubber Products

Mo.	1948 Production Workers (thousands)	1948 Average Weekly Earnings	1948 Average Weekly Hours	1948 Average Hourly Earnings	1949 Production Workers (thousands)	1949 Average Weekly Earnings	1949 Average Weekly Hours	1949 Average Hourly Earnings
Jan.	220	$56.63	39.6	$1.430	201	$56.89	37.9	$1.501
Feb.	219	54.35	38.6	1.408	197	56.55	37.7	1.500
Mar.	215	53.09	38.0	1.397	194	55.43	37.0	1.498
Apr.	208	53.24	38.0	1.401	190	55.50	36.9	1.504
May	203	55.28	38.9	1.421	185	57.08	37.7	1.514
June	205	57.33	39.7	1.444	181	58.29	38.2	1.526
July	201	58.32	39.7	1.469	177	58.37	38.4	1.520
Aug.	205	60.33	40.3	1.497	180	57.61	38.2	1.508
Sept.	207	59.25	39.5	1.500	169	60.93	40.3	1.512
Oct.	208	58.96	39.2	1.504	189	....	....	....
Nov.	209	58.20	38.7	1.504	....	....	....	....
Dec.	206	57.67	38.5	1.498	....	....	....	....

Tires and Tubes

Jan.	104.0	62.60	38.1	1.643	91.3	60.72	35.3	1.720
Feb.	102.3	58.19	36.1	1.612	89.4	60.99	35.4	1.723
Mar.	99.6	55.61	34.8	1.598	88.6	61.50	35.8	1.718
Apr.	95.7	56.64	35.4	1.600	88.6	60.92	35.4	1.721
May	94.4	61.24	37.5	1.633	87.2	63.20	36.3	1.741
June	95.0	64.15	38.9	1.649	86.3	64.09	36.6	1.751
July	94.0	66.10	39.3	1.682	82.0	64.45	36.6	1.761
Aug.	94.7	68.26	39.5	1.728	79.9	62.01	35.8	1.732
Sept.	94.4	65.57	37.9	1.730	....	70.03	39.1	1.791
Oct.	93.1	64.50	37.2	1.734	....	....	....	....
Nov.	94.3	62.66	36.2	1.731	....	....	....	....
Dec.	92.7	61.20	35.6	1.719	....	....	....	....

Rubber Footwear

Jan.	24.6	50.90	42.1	1.209	24.8	51.86	40.2	1.290
Feb.	24.9	50.33	41.7	1.207	22.9	48.15	37.5	1.284
Mar.	24.7	51.03	42.1	1.212	21.9	42.07	33.6	1.252
Apr.	24.2	50.33	41.7	1.207	21.4	46.65	37.2	1.254
May	23.9	50.21	41.6	1.207	....	49.45	38.9	1.267
June	24.0	50.33	41.7	1.207	....	50.35	39.4	1.278
July	22.8	51.32	42.1	1.219	....	48.84	38.7	1.262
Aug.	24.2	51.79	41.5	1.248	....	48.86	38.9	1.256
Sept.	24.7	52.46	41.5	1.264	....	51.71	40.4	1.280
Oct.	25.2	53.26	42.0	1.268	....	....	....	....
Nov.	25.5	54.04	41.6	1.299	....	....	....	....
Dec.	25.9	54.82	42.3	1.296	....	....	....	....

All Other Rubber Products

Jan.	91.8	51.36	40.6	1.265	85.3	54.38	40.1	1.356
Feb.	91.6	51.20	40.6	1.261	85.1	54.05	40.1	1.348
Mar.	90.5	50.70	40.3	1.258	83.1	52.49	39.2	1.339
Apr.	88.4	50.18	39.7	1.264	79.6	51.69	38.4	1.346
May	84.6	49.94	39.6	1.261	....	51.82	39.1	1.326
June	86.4	51.85	40.1	1.293	....	53.85	39.8	1.353
July	84.5	51.38	39.4	1.304	....	54.11	40.2	1.346
Aug.	85.9	53.90	40.8	1.321	....	55.27	40.4	1.368
Sept.	97.9	54.28	40.6	1.337	....	56.28	41.2	1.366
Oct.	89.3	54.84	40.5	1.354	....	....	....	....
Nov.	88.9	54.54	40.4	1.350	....	....	....	....
Dec.	87.2	54.88	40.5	1.355	....	....	....	....

Source: U. S. Departments of Commerce and Labor.

Note: Data are based upon reports from cooperating establishments covering both full and part-time employees who worked during or received pay for the pay period ending nearest the 15th of the month. The employment series have been adjusted to levels indicated by Federal Security Agency data for 1947, and have been carried forward from 1947 bench-mark levels, thereby providing consistent series. Hours and earning data pertain only to production and related workers.

Production Index for the Rubber Industry

Production 1935-1939 = 100

(Based on man-hours)

	1947	1948	1949		1947	1948	1949
Jan.	247	223	193	July	207	200	175
Feb.	246	215	188	Aug.	210	207	178
Mar.	239	205	182	Sept.	217	205	176
Apr.	234	200	177	Oct.	223	205	182
May	220	201	178	Nov.	225	203	....
June	216	205	178	Dec.	230	200	....

Source: U. S. Department of Commerce.

Sales by the Rubber Industry

(In Millions of Dollars)

	1947	1948	1949		1947	1948	1949
Jan.	289	271	260	July	290	331	271
Feb.	299	265	251	Aug.	291	331	295
Mar.	302	270	260	Sept.	315	317	277
Apr.	291	285	257	Oct.	309	294	244
May	276	273	248	Nov.	311	291	....
June	271	299	266	Dec.	276	280	....

Source: U. S. Department of Commerce.

Rubber Manufacturers' Inventories

(Based upon Book-Value)

(In Millions of Dollars)

	1947	1948	1949		1947	1948	1949
Jan.	502	608	661	July	588	648	625
Feb.	519	625	661	Aug.	566	641	586
Mar.	534	634	653	Sept.	553	661	562
Apr.	564	625	648	Oct.	552	650	555
May	584	632	650	Nov.	550	667	....
June	593	645	644	Dec.	579	650	....

Source: U. S. Department of Commerce.

Various Compounding Materials Consumed by the Rubber Industry

Material	1942	1943	1944	1945	1946	1947	1948
Asphalt [a]							
Short tons	22,263	16,510	20,189	19,483	28,715	32,113	19,967
% of total	.006	.005	.006	.005	.007	.007	.004
Barite (Barytes):							
Short tons	6,334	8,000	10,000	10,000	20,000	17,000	18,000
% of total	3.6	3.9	2.9	2.1	4.4	3.1	2.85
Carbon Black:							
Short tons	147,974	236,737	369,015	402,193	470,732	471,790	424,038
% of total	88.5	90.3	94.6	95.5	95.3	94.3	91.0
Clay, Kaolin:							
Short tons	51,334	50,964	59,588	109,936	162,393	166,201	176,965
% of total	5.1	5.5	6.8	11.7	12.3	11.5	11.3
Clay, Fire & Stoneware:							
Short tons	5,000	10,259	7,160	7,800	12,951	17,970	15,480
% of total	0.1	0.2	0.1	0.1	0.2	0.2	0.2
Lead Sulfate, Basic:							
Short tons	89	131	268	200	.....	.....	.....
% of total	1.1	2.3	4.2	5.2	..	..	..
Lime:							
Short tons	1,381	2,039	5,634	7,170	3,193	589	.....
% of total	0.02	0.05	0.13	0.10	0.1	0.01	..
Litharge:							
Short tons	3,460	4,302	3,023	1,864	2,131	2,205	2,835
% of total	3.8	3.8	2.2	1.3	1.6	1.3	1.8
Lithopone:							
Short tons	1,047	1,078	726	977	1,607	3,085	4,192
% of total	0.8	0.8	0.5	0.7	1.1	1.9	3.0
Mica, Ground:							
Short tons	1,754	3,063	1,137	3,715	4,951	3,900	.....
% of total	3.7	6.0	2.2	7.1	8.0	6.0	..
Sulfur:							
Short tons	40,000	51,000	63,000	64,960	72,800	72,800	70,560
% of total	1.4	1.8	1.9	2.0	2.2	1.8	1.7
Talc [b]							
Short tons	40,487	48,994	51,833	63,758*	65,980	71,840	66,226
% of total	10.0	11.8	13.0	16.0	14.4	13.9	13.0
Zinc Oxide:							
Short tons	52,717	67,898	59,518	63,447	83,776	82,248	82,895
% of total	53.0	47.4	42.3	49.6	53.1	51.2	54.9

Source: U. S. Bureau of Mines.

Notes: (a) Solid and semi-solid products of less than 200 penetration. (b) Includes pyrophyllite and ground soapstone. * Revised.

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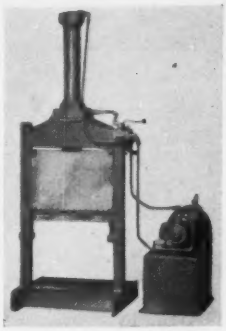

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